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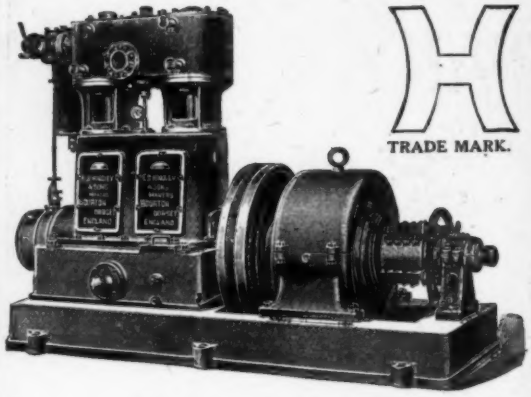

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1920.

It is with no feeling of regret that we write the epitaph of 1920. Its immediate predecessor was bad enough, and twelve months ago we were looking forward hopefully to a new epoch—to the reaping of the harvest of peace and prosperity for which the seed had been sown in sorrow and adversity. But our fond hopes were doomed to disappointment. Then we said: "Nationalisation demands, incessant agitations for higher wages and shorter hours, efforts to secure 'control,' the railway strike and struggle with the community, the continued increase in the cost of living, the serious developments in rates of exchange, the ever-growing burden of national finance—these are some of the leading questions of the year." Substituting "mining" for "railway," precisely the same paragraph would equally hold good for 1920. *Plus ça change, plus c'est la même chose.* The turnover from war work to peaceful production completed, we looked for a vast output and universal progress towards renewed prosperity, foretelling for the electrical industries "a boom . . . if the menace of industrial unrest and financial stress do not assume serious shape." Unfortunately, that essential condition was not fulfilled; unrest there has been in plenty, and the crushing burden of the excess profits duty, income tax, and other imposts has bled industry white, while the exchanges impose an immense handicap upon our foreign trade. Thanks to the high cost of labour, resulting also in high cost of materials, and the uncertainty as to the future, not only of wages but also of output, British manufacturers could not quote either fixed prices or definite dates for delivery, and here again they were at a heavy disadvantage in competition with other countries. And now, to crown the tale of woe, a wave of unemployment has swept over the land, necessitating further expenditure on unproductive works in order to stave off starvation and disorder.

But are we Britishers downhearted? Surely not! The darkest hour comes before the dawn, and we are confident that we are not mistaken in our interpretation of various signs, individually of small moment, but in the aggregate of great import, that the worst has been passed and things are on the mend. The cost of commodities is decreasing; according to the *Times* of January 1st, the total fall in wholesale prices was 11 per cent. in November and 6.7 per cent. in December. The average level of food values declined 7.5 per cent. in November and 4.8 per cent. in December, and as there has been a steady fall since April, prices are down almost to the level of December, 1918. The reduction in the index number during the year was 19 per cent., mainly due to a fall of 32 per cent. in the prices of raw materials, the index numbers being for December 31st, 1919, 296.9, and for the end of 1920, 240.3 (at December 31st, 1913, 100). In July last the highest point was reached (305.8). Further reductions are imminent, and though it takes some time for them to reach the retail consumer, it is unquestionable that food and clothing in particular are materially cheaper than they have been. Copper, lead, and spelter are almost down to the pre-war level, and rubber is far below it; coal and coke, unfortunately, remain at a high price.

Turning to taxation, it cannot be doubted that the earnest protests and appeals of manufacturers against the excess profits duty, and the disappointing results obtained from it, will secure its withdrawal in the

D

coming Budget; purely a war-time tax, it has not merely proved unsuitable to the conditions obtaining since the war, it has produced a disastrous effect upon industry. At any time it affords a direct incentive to extravagance, for a manufacturer is prone to regard an extra outlay of £100 as only £40 out of his own pocket and £60 out of the Exchequer; we do not commend this attitude of mind—we merely record the fact that in many quarters it undoubtedly exists. But apart altogether from this feature, the duty has pressed with crushing weight upon the patriotic firms who recognise the necessity of taxation, but are faced with the facts that their working capital nowadays must be trebled in comparison with pre-war requirements, that new capital is almost unobtainable, and that they must provide the money out of revenue. The situation is an impossible one, and clearly E.P.D. must go, if our industries are to survive the strain.

With regard to labour, again the prospects are brighter than they were a year ago. There is now manifest a marked disinclination on the part of the trade unions to resort to the strike weapon, and a disposition to discuss the situation with the employers. Obviously, in the face of growing unemployment and vanishing profits, to strike for higher wages would be the height of folly. Every encouragement should be given to the tendency towards friendly discussion across the table, and the fullest information should be furnished to the accredited representatives of the workers; nothing more effectively nourishes suspicion and dissatisfaction than undue reticence on the part of the employers, who are so commonly believed to be amassing wealth at the expense of the workers. Experience on the Whitley Councils has abundantly proved that frank and open conversation softens asperities, smooths away misunderstandings, and enables both parties to acquire that confidence in and respect for each other as men, which goes so far towards the maintenance of cordial relations. Lack of mutual trust is perhaps the greatest of all hindrances to hearty collaboration.

That the restriction of output has played a great part in the development of the present situation cannot be seriously disputed. Although far-seeing Labour leaders have pointed out that increased production is the key to the problems of industry, the workers have not followed their lead—fearing that the result would be unemployment. Well—they have tried their own way, and they have found that it leads directly to the danger that they sought to avoid; will they not now be willing to make trial of the other path? Surely it is a matter of plain common-sense. When one finds oneself in a fog walking towards the brink of a precipice, one naturally turns round and hastens in the opposite direction. Unfortunately, it is much easier to go downhill than uphill; a year ago we were on the crest of the hill, in sight of a world crying out for supplies of manufactured goods; we no longer have that fair prospect before our gaze—the world, appalled at the prices of commodities, has closed its purse. It will be a hard struggle to regain our commanding position—but the world's demand, though now restrained, remains unsatisfied. Immense developments await the restoration of normal conditions, and it should be our earnest endeavour to turn out the maximum quantity of goods at the lowest possible prices. That is what the Germans are doing already. Let us beware lest, beaten in war, they defeat us in the arts of peace.

What is needed to remedy the evils under which we labour is a change of spirit. We hear much about "rights," but little about "duties." As in wartime, so now in peacetime, the spirit of self-sacrifice is the key to the welfare of the nation. So long as each strives for his own advancement regardless of the happiness of others, so long shall we flounder in the depths of depression. Let us rather all strive after mutual understanding, good-fellowship, and cheerfulness, and let each "do his bit" to make the world a better place for his fellows to live in. By so doing all will benefit, and the dawn of a new era will shine forth.

Wages Agreement, Greater London Industrial Council.

We notice that this much-discussed agreement has drawn down upon it a veritable broadside of criticism from the *Financial Times*. The article is headed "Tyranny of Labour" and "New Stranglehold on Industry." We can hardly agree to the first of these titles, since, after all, the agreement is a joint one of both sides of the Greater London (No. 10) Industrial Council, and the sub-heading also is perhaps somewhat too emphatic, however much the agreement may tie up the undertakings! The essence of the agreement is that an increase of wages shall take place with every complete ten points rise over the 150 per cent. cost of living, and that this shall be taken off with the fall of the ten points. The agreement is supposed to bind all the undertakings in the Greater London area. It is, of course, a serious compact to enter into, but on the other hand, any alternative is also serious, even that of maintaining the *status quo*.

There is one point in the *Financial Times* criticism which certainly merits serious consideration, namely, the suggestion that big London undertakings will still be as vulnerable as ever to a strike. The agreement states in the preamble that its one purpose is "that the supply of electricity may be carried on continuously without interruption." But there is nothing in the agreement which gives any guarantee whatever. The *Financial Times*, in fact, thinks that the danger is increased, since if one or two small undertakings in the London area do not put it into operation, the trade unions give no guarantee that they will not call a strike on the big undertakings in order to coerce the recalcitrant ones, and, of course, no one can shut his eyes to the possibility of London being used as a lever on other occasions. This being so, would it not be possible for the National Council, when the agreement comes before it for final approval, to agree to some sort of clause which shall provide a safeguard to those London undertakings which faithfully carry out the provisions? Otherwise, if no such safeguard is embodied in the agreement, it is difficult to see how the agreement by itself will prevent strikes in London.

So far as the other District Industrial Councils are concerned, their view seems to be that the agreement should not be ratified by the National Council until they have had an opportunity of considering it, since if a similar agreement were presented to the District Councils they would feel their case prejudiced if the trade unions brought it forward with the claim that such agreement had already been approved by the National Council. It is indeed difficult to see how the approval of the National Council to the London agreement could be so given as not to constitute an approval covering the principle as well as the detail and individual application, and if the National Council approved the principle, the District Councils would seem to have no option but to accept. We understand, however, that the air will be somewhat cleared before the National Council has to give its verdict, since in the interim the employers' sides of the various District Councils will have an opportunity of considering the matter in conference, and submitting a consensus of opinion to the National Council.

Joint Electricity Authorities.

With regard to the thirteen electricity districts which have been provisionally delimited, the schemes for most of these are not due for consideration for at least a few months. When these schemes are forthcoming, it will be interesting to see whether all of them include the formation of a Joint Electricity Authority. It will be remembered that under the Electricity (Supply) Act, 1919, any schemes can be brought forward which purport to improve the "organisation of the supply of electricity in any district." These schemes may or may not, under Section 6 of the Act, provide for the establishment of a Joint Electricity Authority. An article on this subject appeared in a recent issue of the

Times Engineering Supplement, in which the pros and cons with regard to the formation of such authorities were weighed. Under Section 6, of course, the Joint Authority may exercise "all or any of the powers of the authorised undertakers within the electricity district," and it may also have transferred to it "the whole or any part of the undertakings of any of those undertakers." A good many arguments were advanced in the article mentioned against the formation of such fully operative Joint Authorities.

We may suggest that there is a middle course by which, although a scheme might be carried on jointly by certain undertakers in the area, perhaps merely one or two, a Joint Authority might still be formed as a regulating and supervising board which would be representative of the various interests enumerated in Section 6, but which would have only administrative functions, that is, it would not become the trading body. This would seem to be a likely solution in some areas. In the Electricity (Supply) (No. 2) Bill, Section 11 provides that where a generating station or main transmission line becomes transferred to or is acquired by a Joint Authority, the said authority may (subject to the approval of the Electricity Commissioners) delegate to the former owner the working and maintenance thereof on behalf of the authority, by mutual agreement; and Section 12 enables the authority to delegate the whole of its powers and duties as regards the generation and supply of electricity to any authorised undertakers, subject to a special order being obtained. The great difficulty of discussing the question broadly is that every district is in a different position, and what may suit one district may not be at all applicable to another. The wisdom of the Act in leaving open the exact system of reorganisation in each district to be settled for each district separately will gradually be more and more fully appreciated. Indeed, the chief requirement in settling what has to be done in each district is that there should be no fixed theoretical model which each is supposed to follow. Each district is, as it were, in a different state of evolutionary development. They are like humanity in being of all sizes and conditions, and hence requiring, not a ready-made Government suit, but something cut to measure.

More Municipal Trading.

In days gone by we have often had occasion to deal with the question of municipal trading. The Legislature, for good or ill, has frequently authorised this form of enterprise, but it is interesting to notice that the Courts are not inclined to allow local authorities to exceed their statutory powers. The recent case of *Attorney-General v. Fulham Corporation*, reported in *The Times* of December 3rd and 4th, is a useful illustration. It seems that the Fulham Borough Council, having power to establish baths and wash-houses and to afford facilities by which persons might, in wash-houses, do their own washing, sought to extend the sphere of operations.

On the recommendation of the Establishment Committee, the Council inaugurated a scheme by which the washing was to be done by servants of the Council itself. The Attorney-General, at the instance of a ratepayer, brought an action to restrain it from exercising these extended powers. Mr. Justice Sargant, in giving judgment against the Corporation, pointed out that in considering what the powers of a Corporation were, it was necessary to remember what Lord Selborne had said as to the doctrine of *ultra vires* (that is to say, the doctrine according to which a Corporation must not exceed the powers conferred upon it by statute) in *Ashbury Railway Co. v. Riche* (L.R. 7 H.L. 653). His Lordship had said: "this doctrine ought to be reasonably and not unreasonably understood or applied, and that whatever may fairly be regarded as incidental to, or consequent upon those things which the Legislature has authorised, ought not (unless expressly prohibited) to be held by judicial construction to be *ultra vires*." Applying that doctrine, he could not hold that power to provide washing apparatus for the ratepayers could be held to confer power to wash clothes for others. It may be useful for those who are concerned with the supply of electricity to have this case in mind, having regard to the attempts which are sometimes made by local authorities to exercise powers for which there is no sanction. It should be mentioned that it was long since decided (viz., in the case of the *Attorney-General v. Corporation of Leicester*, 1910, 2 Ch. 359) that in the absence of statutory authority municipal electricity supply undertakers could not provide lamps, fittings, motors, or apparatus other than meters which were provided for by various clauses in the schedule to the Electric Lighting (Clauses) Act, 1899. Such statutory authority was given in the Act of 1919, Section 23, which enables all municipal supply authorities to provide, let for hire, connect, repair, maintain, and remove all kinds of electrical apparatus, but explicitly forbids them to manufacture or sell the same ("unless expressly authorised to do so" by their special Acts or orders).

The Law of Nuisance.

The recent case in which Mr. Justice Astbury granted an injunction to restrain a firm of builders from causing a nuisance by noise draws attention to the fact that all who carry on their business in a residential district are bound to have regard to the nerves of their neighbours. To this rule those who supply electricity are no exception.

Time was when our columns frequently contained the reports of cases in which electricity supply authorities were made defendants to actions for nuisance. It would seem, however, that people's nerves are not quite so susceptible to this kind of disturbance in these later days, for such actions are seldom heard of at the present time. Improvements in machinery have undoubtedly contributed to this result. The production of unnecessary noise means a futile waste of energy, and improvements have taken place in this direction. Again, the gradual suppression of small generating stations has led to a diminution in the number of houses which are within reach of noise or vibration. There is probably a disposition on the part of the public to regard any nuisance which does arise in the course of generating electricity as a necessary evil. It is also a well-recognised fact that long habit will accustom a man to any form of noise. We recall the case of a Welsh doctor whose quarters were situated close to a colliery engine house. Year in, year out, a great ventilating engine was at work, and the exhaust pipe made a roaring sound at regular intervals outside his bedroom window. He grew quite used to it. On one occasion he woke up suddenly in the night thinking it was a night call, only to find that the cause of his awakening was a sudden cessation of the familiar sound.

While actions for nuisance have become more rare of late, the possibility of trouble and litigation on this ground cannot be altogether removed from the purview of the station engineer. In this connection it is well to mention that by S. 81 of the Schedule to the Electric Lighting (Clauses) Act, 1899, it is provided that: "Nothing in the special order shall exonerate the undertakers from any indictment, action, or other proceedings for nuisance in the event of any nuisance being caused or permitted by them."

By virtue of this section undertakers are liable to an injunction and damages if they cause a nuisance, whether by noise or vibration, in working their generating station or by the escape of electricity from their mains, or by smoke, water, coal dust, &c., quite apart from negligence, and it is no defence to an action for the company to prove that the person complaining took up his residence in the district long after the works were established, and in such circumstances that he must have known of the existence and probable continuance of the nuisance.

THE ELECTRICITY DISTRICTS.

IN their endeavours to reorganise the supply of electricity, the Electricity Commissioners have up to the present provisionally delimited 13 separate electricity districts for the purposes of Sec. 5 of the Electricity (Supply) Act, 1919, and a number of local inquiries are to be held from this month onwards with a view to permanently determining the accompanying map. Any interested body or person may attend the inquiries, either in person, or by his agent, legal or other representative, and for information regarding the jurisdiction of the Electricity Commissioners, p. 739 of our December 10th, and p. 646 of our May 21st, issues may be consulted. The districts are enumerated below in the

MAP OF ELECTRICITY DISTRICTS PROVISIONALLY DELIMITED BY THE END OF 1920.

area to be included in each district. At the inquiries consideration will also be given to the schemes which have been submitted for effecting improvements in the existing organisations for the supply of electricity in, and for the formation of Joint Electricity Authorities to control, the various districts, the location of which is indicated on the order in which they were provisionally determined by the Electricity Commissioners.

1. *The West of England, or Lower Severn, Electricity District* (pp. 624 and 646 of our May 14th and 21st issues) was not only the first one to be provisionally specified, but also promises to be the first to be permanently

defined. A local inquiry for that purpose will take place on January 11th and subsequent days, and a draft proposal for the formation of a Joint Authority is to be put forward by the Bristol City and other interested authorities. Incidentally, the Severn Barrage, which the Ministry of Transport has proposed to build to enable tidal energy to be utilised to generate electricity (pp. 705 and 713 of our December 3rd, and p. 762 of our December 10th issues), if it is ever realised, will be situated in this district.

The outstanding electricity supply undertaking in this large district is that owned by the Bristol Corporation, having a plant capacity of over 24,000 kW. Hereford is worthy of notice both on account of its interesting rural supply network, and of being second in size with a capacity of 4,610 kW. Next comes the Cheltenham undertaking, which is followed by Swindon and Gloucester City. The City of Bath apparently does not wish to commit itself in the formation of a Joint Authority. Another station is situated at Weston-super-Mare. In addition there is a number of small stations generally supplying d.c. scattered over the area. As it is proposed that the voting power of the various members forming the Joint Authority shall be proportional to the number of units sold per annum, it will be recognised that the Bristol undertaking will be the dominating one in this area.

2. *The Mid-Lancashire Electricity District* (see p. 720 of our June 4th, and p. 764 of our June 11th, 1920, issues), in contrast to the above-mentioned one, is a thickly populated industrial area, though not so large as the Bristol area. Blackburn and Preston form practically the centre of the district. The former undertaking has a capacity of 8,000 kW; the common periodicity of 50 is shared with Preston, which has a capacity of 3,190 kW, and is the only important company-owned concern in the area. Burnley has a 5,250-kW capacity, and a considerable traction load, while the well-known summer resort, Blackpool, has 6,950 kW of plant. In July last the foundation stone of the new Whitebirk station at Blackburn was laid, and it was proposed to build a second station on the River Ribble at Preston, where a dam was to be constructed. The demand for electricity is increasing so rapidly, owing to the electrification of mills, factories, &c., that most of the additional output that will be available, when the various extensions that are in hand are completed, has already been allocated.

3. In the *West Riding* (*Aire and Calder*) *Electricity District* (see p. 815 of our June 25th issue), including, as it does, one of our principal manufacturing districts, it is essential that the best use should be made of the available supply. A large number of power stations are situated in this area; the Yorkshire Electric Power Co. has two stations, one at Dewsbury and the other at Barnsley, and supplies a large number of local authorities, collieries, factories, &c., in addition to bulk supplies to other authorities. Amongst the municipal undertakings in the area are those at Leeds, Bradford, Halifax, Huddersfield, Wakefield, &c.

4. *The South-East Lancashire Electricity District* (p. 815 of our June 25th issue) includes some very important municipal undertakings, such as those at Manchester and Salford, between which there is a 33,000-V underground interconnecting line (see p. 355 of our March 19th issue). Manchester's application for permission to construct a new station at Barton, to have a possible ultimate capacity of 150,000 kW, has been sanctioned. A number of county boroughs have their own electricity supply undertakings, while several urban districts are served by the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, and others by the Lancashire Electric Power Co. One or two authorities have obtained Provisional Orders enabling them to supply electricity in certain areas, which powers have, however, not as yet been exercised.

5. *The London and Home Counties Electricity District* (see p. 106 of our July 23rd, 1920, issue), demands careful consideration not only by reason of its inclusion of the whole of the Metropolis and "Greater London," but also because of the large number of electricity supply undertakings involved. A tentative proposal for the formation of a Joint Authority for the district has been put forward by the London County Council (see our issues of October 15th, p. 481; November 12th, p. 610; December 3rd, p. 706, and 10th, p. 744), and the inquiry which will be held in connection with this area should be the most interesting of all. The conditions obtaining in London differ widely from those in any other electricity district, and the various interests involved will need very careful consideration if a scheme is to be evolved which will be satisfactory to all concerned.

6. *The Mersey and West Lancashire Electricity District* (see our issue of July 23rd, p. 106) includes about half-a-dozen large electricity generating stations, in addition to a number of smaller ones. The Liverpool undertaking is probably the most important one, and a scheme for the formation of a Joint Authority has been submitted to the Electricity Commissioners. A rival scheme has also been put forward, by which it is proposed to split up the area and to form a separate area to be termed the Wirral Electricity District, which will include the south-western portion only of the district that has been provisionally determined by the Commissioners (see p. 11 of this issue). All the schemes for the constitution of Joint Authorities that have so far been submitted are in the main similar, differing only in minor points.

7. *The North Wales and Chester Electricity District* (p. 107, July 23rd) includes only one county borough, namely, that of Chester, which is of interest on account of its hydro-electric plant with a capacity of 2,170 kW, which was inaugurated in 1913. A scheme for the constitution of a Joint Authority to control the district has been prepared by the Corporation and the North Wales Power and Traction Co., but not yet published. There are several small electricity supply undertakings situated within the area, which also possesses in the aggregate considerable potential water power; several parts of the district are, nevertheless, not well off as far as public supplies of electricity are concerned, indeed several districts have no supplies whatever.

8. *The North-West Midlands Electricity District* (p. 370 of our September 17th issue) is of interest, inasmuch as the Shropshire, Worcestershire and Staffordshire Electric Power Co. has power to supply a large part of the area, although its power stations are located at Dudley, Smethwick and Kidderminster, which towns are just outside the scheduled district. It is unnecessary to emphasise the importance of this area, including as it does mines, potteries, ironworks, and other great industries; it will suffice to record that several important municipal undertakings are situated within the district, namely, those at Wolverhampton, Walsall, West Bromwich, Stafford, and Stoke-on-Trent.

9. *The North-East Midlands Electricity District* (p. 434 of our October 1st issue) needs no introduction, being already world-famed for its steel production, cutlery and allied trades. During the war period the increase in the demand for electricity in the area was phenomenal, and electric furnaces were adopted freely in the manufacture of munitions of war. The two outstanding electricity supply undertakings in the district are those at Sheffield and Rotherham, the former with a capacity of 68,700 kW, and the latter with 70,500 kW. Rotherham recently inaugurated a new generating station, being the first "super-station" to be placed in commission in this country, in which the largest turbo-generator set yet used in this country is installed—namely, a 30,000-kW machine. There are several other stations in the area, but mention need only be made of those at Chesterfield, Mexborough, and Doncaster; it also includes the well-known health resort of Buxton.

10. *The South-West Midlands Electricity District* (p. 434 of our October 1st issue) includes in its southern portion the celebrated fruit orchards of Pershore and Evesham, while the beautiful Malvern Hills and the health resorts of Droitwich and Worcester are too well known to escape notice. From a technical point of view, however, the centre of interest will undoubtedly be Birmingham, in the north-east portion of the area. The municipal undertaking has a capacity of 67,666 kW, and those who know the city and its adjacent area will appreciate the existing and potential demand for electricity in the neighbourhood. As mentioned above, the border line of this area just takes in the three stations owned by the Shropshire, Worcestershire, and Staffordshire Electric Power Co.

11. In the *South Wales Electricity District* (p. 591 of our November 5th issue) a commencement has just been made towards the formation of a Joint Authority (p. 809, December 24th issue). The district is an important coal-producing centre, and the Ebbw Vale Iron and Coal Co., with its extensive undertakings, will probably exercise substantial influence on the formation of a Joint Authority. Of the electricity supply undertakings affected, the South Wales Electrical Power Distribution Co. deserves notice, not only because it is probably the largest, but also because it operates a considerable mileage of both underground and overhead transmission lines. Of the municipal undertakings involved, those at Cardiff, Newport (Mon.), and Swansea may be noted, and there is, in addition, quite a number of other stations, some of which are privately owned, such as that belonging to the Ebbw Vale Co., which is of considerable size, and numerous smaller ones.

12. *The East Midlands Electricity District* (p. 591, November 5th) is of interest in view of the recent inquiry into the application of the Nottingham Corporation for permission to erect a large new generating station (p. 155, July 30th, and p. 401, September 24th). It will be remembered that the Electricity Commissioners decided in favour of the municipal proposition and against the opposition scheme which was put forward by the Derbyshire and Nottinghamshire Electric Power Co. At Derby and Leicester are located two other large stations, while, in addition to the above-mentioned company, the Leicestershire and Warwickshire Electric Power Co. has power to supply portions of the area under consideration; its stations are, however, outside the boundary of the district.

13. *The North Lancashire and South Cumberland Electricity District* (p. 721, December 3rd) neither includes a large area nor many large public generating stations; by far the largest is Barrow-in-Furness, round which town is grouped the chief industrial area of the district. The only other undertakings of any importance are those at Lancaster and Morecambe. The picturesque lake districts of Ulverston, Windermere, Ambleside, and Grasmere are in this district.

In conclusion, it may be pointed out that an interesting discovery has been made as a result of outlining the provisional boundaries of the separate districts on a single map. It will be seen that District 1 includes the Rural District and City of Hereford, but, curiously enough, the other part of the County of Hereford which is bounded by Districts 1, 10 and 11 is in none of them, and appears to have been left out in the cold.

GEARING CONSTANTS OF ELECTRICITY METERS.

By G. W. STUBBINGS.

THE operation of testing an electricity meter by a revolution or speed test consists in determining the relation between the angular speed of the rotor and the load passing through the meter, and comparing the constant representing this relation of proportionality with the "testing constant" as furnished by the makers of the meter. It is at once apparent that these two constants are quite different in physical significance, the one determined by the revolution test is a characteristic of the meter, and although a constant, or approximately so, with regard to the particular test, this characteristic is liable to change over long intervals of time. The constant furnished by the makers, however, is a property of the gearing of the meter counter, and the operation of calibrating the meter is either to modify the characteristic of the meter to suit the gearing constant, or alternatively to alter the gearing constant to suit the meter characteristic.

Although the testing constant of a meter is always furnished by the makers, it is often advisable to check the information so given by an examination of the gearing. Although this would not seem a very difficult matter, there are many to whom it would give considerable trouble, and the general problem is not made easier by the fact that the testing constant is given by various makers in several different forms. The following examples, in which the numerical connection between the values of the wheel trains and meter constants of various types is worked out in detail, it is hoped may be of use to meter repairers and testers, to whom these matters have not been any too clear.

The fundamental constant of an electricity meter is the number of revolutions executed by the rotor during the passage of one unit. If the meter is to register correctly, it is obvious that this number must be identical with the number of revolutions of the rotor required for one revolution of the $\frac{1}{10}$-unit spindle of the counter. The gearing ratio between the rotor and the $\frac{1}{10}$-unit spindle must, therefore, be equal to the number of revolutions per unit as determined by the speed test. It is to be observed that the quantity "revolutions per unit" has a different significance with a watt-hour meter from what it has with an ampere-hour meter calibrated to register units. In the case of a watt-hour meter, this constant is the number of revolutions of the rotor corresponding to the actual passage of one unit. In the case of the ampere-hour meter the constant is the number of revolutions corresponding to a quantity Q such that $1{,}000\ Q\ V = 1$ where V is the rated voltage of the meter. Since the ampere-hours corresponding to one unit are 1/1,000 V, the "revolutions per unit" constant, and therefore the gearing constant, will vary according to the rated voltage of the meter.

If the testing constant of the meter is given in the "revolutions per unit" form, this constant can at once be checked by calculating the gearing constant, it being remembered that the velocity ratio of toothed gearing is inversely proportional to the respective numbers of teeth in the wheels engaging, and that the ratio of a worm-and-worm-wheel pair is the reciprocal of the number of teeth in the worm wheel for a single worm.

Although the "revolutions per unit" constant is really the fundamental one, it is not the one best adapted for testing purposes. A very usual constant for ampere-hour meters is the ampere seconds per revolution ratio. "Revolutions per unit" is related to ampere-seconds per revolution in a very simple way—

$$\text{Since units} = \text{amps.} \times \text{secs.} \times V/3{,}600{,}000,$$
$$K = \text{revs./units} = \text{revs.} \times 3{,}600{,}000/\text{amps.} \times \text{secs.} \times V,$$
$$\text{and amps.} \times \text{secs./revs.} = 3{,}600{,}000/K \times V.$$

To illustrate this the case of the counter train of a Chamberlain & Hookham meter may be considered. An eight-tooth pinion on the rotor spindle gears with a variable change wheel of N teeth. A double worm on the change wheel spindle gears into an 80-tooth worm wheel; an eight-tooth pinion on this last spindle gearing into an 80-tooth wheel on the $\frac{1}{10}$-unit spindle.

The gearing constant is then $(N/8) \times (80/2) \times (80/8) = 50\,N = K$, and this is the number of revolutions of the rotor per unit for correct registration.

From the above equation—

$$\text{amp.} \times \text{secs./revs.} = 3{,}600{,}000/K \times V$$
$$= 3{,}600{,}000/50 \times N \times V,$$

giving the relation between the constant and the number of teeth in the variable change wheel for any voltage. If, for instance, $V = 230$ and $N = 72$, the constant is found to be 1,000/V, or 4·35.

In the above case it is clear that for any constant the product $N \times V$ is constant, and that to adjust the meter to read correctly on a voltage different from that for which it is rated, a new wheel must be fitted according to the condition $N' = NV/V'$, an increase in voltage requiring a smaller wheel. This, of course, only applies when the variable wheel is a driven wheel; had it been a driving wheel, N would have been proportional to the voltage—a single worm, for instance, being required in the above train for 115 volts, since the worm is a driving element.

As a further example, the train of a Ferranti d.c. meter may be worked out. In a meter of this type a single worm on the rotor spindle engages with a 50-tooth worm wheel; on the worm wheel spindle is a variable pinion of N_1 teeth engaging with a variable change wheel of N_2 teeth; on the last spindle is a 10-tooth pinion engaging with a 100-tooth wheel on the $\frac{1}{10}$-unit spindle.

$$K = (50/1) \times (N_2/N_1) \times (100/10) = 500\ N_2/N_1,$$

and amp. $\times$ secs./revs. $= 3{,}600{,}000 \times N_1/V \times 500 \times N_2$;

taking $V = 230$, the variable pinion with 50 teeth, and the change wheel with 72 teeth, then the

constant $= 3{,}600{,}000 \times 50/230 \times 500 \times 72 = 21{\cdot}8$.

The calculation of constants of other forms is easily carried out by a preliminary determination of the gearing constant K. Thus—

watt-hours/revs. $= 1{,}000 \times$ units/revs. $= 1{,}000/K$.

Again, $K = 3{,}600{,}000 \times$ revs./(watts $\times$ secs.) $=$ (revs. $\times$ 60/secs.) $\times$ (600,000/watts)

$=$ r.p.m. at full load $\times$ 600,000/full-load watts.

$\therefore$ r.p.m. at full load $= K \times$ full-load watts/600,000.

Calculations regarding trains for prepayment meters are not very difficult, and may perhaps be touched upon. In such a mechanism, a definite fraction, say, $1/n$ of a revolution of the wheel of the epicylic gear actuated by the meter negatives the forward motion given by the epicylic wheel by one coin. If the ratio of the gearing between the last wheel in the prepayment train and the $\frac{1}{10}$-unit spindle be M, then

1 unit gives M revs. of the last wheel.

1 unit requires $M \times n$ coins.

If each coin is a pence, and p is the price per unit,

1 unit requires $M \times n \times a = p$,

this being equivalent to the self-evident fact that the revolutions of the $\frac{1}{10}$-unit spindle required to negative the action of one coin is equal to the ratio, units per coin.

To illustrate the above, the example of the prepayment train of a Vulcan meter may be considered. The value of the train between the escapement and the epicycles was—

$$(15/90) \times (N/80) \times (30/90) \times (45/90) = N/36 \times 80,$$

N being the number of teeth in the pence change wheel.

The wheel of the counter train actuating the escapement made 90 revolutions per unit, and this wheel made one revolution for each revolution of the "scape wheel of the prepayment train."

The total value of the train was therefore—

$$M = 90\,N/36 \times 80.$$

The meter was constructed for pennies, and the last wheel of the train made $\frac{1}{8}$ revolution per coin.

$$p = M\,a\,n = (90\,N/36 \times 80) \times 1 \times 8$$

$$p = N/4$$

$$4p = N,$$

the number of teeth in the variable pinion being equal to the price per unit in farthings.

THE PRODUCTION OF CONTINUOUS OSCILLATIONS IN CIRCUITS WHICH CONTAIN CAPACITIES OF HIGH VALUE.

BY JOHN SCOTT-TAGGART.

IT is frequently desirable to produce a source of oscillating current which may be adjusted between wide ranges of frequency by the simple continuous action of a variable condenser. The most usual circuit for the production of continuous oscillations with a three-electrode vacuum valve involves the use of a retroactor coil which operates only over a certain range of wave-lengths. This range may be considerably increased by winding the retroactor coil with resistance wire, but even so it is not possible to cover the wide ranges to be achieved with the circuits about to be described. Apart from the question of the retroactor, if we tuned our oscillatory circuit with a condenser we would find that, when the capacity of the condenser was above a certain value, the vacuum valve would cease to oscillate.

The circuits shown in fig. 1 and fig. 2 may be used for the production of oscillations of practically all frequencies. For example, with a variable condenser having ebonite dielectric and a fixed inductance of small value, a range of from 100 metres to 30,000 metres was obtained solely by adjusting the capacity of the circuit. Both circuits involve amplification of the timing potentials on the grid, which liberate energy in the anode circuit of the valve acting as a generator. When the capacity of the shunt condenser is large, the potentials across the oscillatory circuit are small, and if communicated in correct phase to the grid would be too weak to produce self-oscillation. These potentials are,

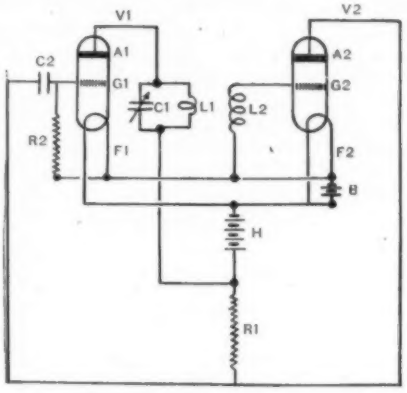


FIG. 1.

therefore, first amplified by one or more three-electrode valves until they are strong enough to maintain the oscillations.

In fig. 1 the oscillatory circuit is shown as L_1 C_1 included in the anode circuit of V_1, the battery H supplying the anode current. Any momentary oscillation in L_1 C_1 is induced into L_2, a coil of high resistance. The potentials across L_2 are communicated to the grid G_2 of V_2 and amplified in the anode circuit A_2 R_1 H F_2 of the second valve V_2. This anode circuit contains a resistance R_1 having a value of about 70,000 ohms (which will be of the same order as the resistance of the filament-to-anode path of V_2). Magnified high-

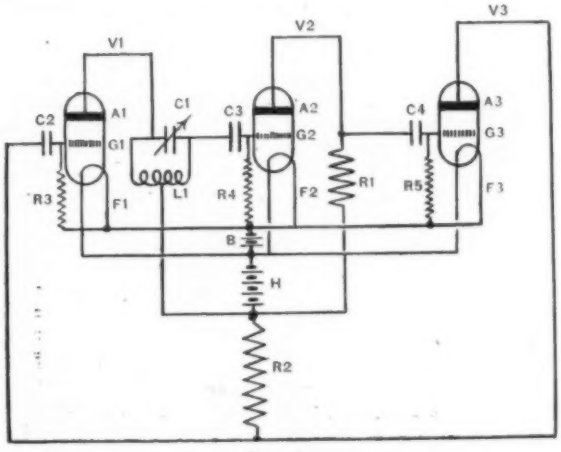


FIG. 2.

frequency potentials will be produced across R_1. The valve V_2 consequently acts practically as an aperiodic amplifier of all frequencies. The potentials across R_1 are now passed to the grid G_1 of V_1, and, if the coil L_2 be connected the right way round, will maintain the oscillations in the circuit L_1 C_1. The condenser C_2 is merely used to prevent the high potential of the anode battery H from influencing the grid G_1. The leak R_2 (of about 2 megohms resistance) keeps the grid G_1 at a suitable normal potential.

The second arrangement (fig. 2) works on exactly the same principle. There is, however, now only one main oscillatory circuit L_1 C_1, no coupling coil being used. The middle tapping of L_1 is connected through H to the filament of the first valve V_1. The potentials across the right-hand

half of L_1 are communicated to the grid G_2 of the second valve V_2 which acts as an aperiodic amplifier, the high-frequency potentials across R_1 being communicated to a third amplifying tube V_3. The potentials across R_2 are brought back to the grid G_1 of the first valve V_1, and are sufficiently strong to produce steady continuous oscillations in the circuit L_1 C_1, even when the value of the capacity of the condenser C_1 is very high. This circuit is also very useful for producing alternations in circuits using iron-core inductances. In these circuits radio-frequency transformers might be used between valves, instead of ohmic resistances.

These arrangements have many applications. The general principle of amplifying the "maintaining potentials" may be used to produce oscillations in an aerial circuit containing an inductance of low value. The chief application, however, is in heterodyne reception. The circuits may be used as external heterodyne oscillators, or as auto-dynes, in which case the aerial and earth might be connected across the condenser and telephones inserted in one of the anode circuits.

CONDENSERS FOR SMALL INSTALLATION WORK.

By L. C. GRANT.

The expense of house installation work has intimidated many a potential consumer. On the other hand, the cost of a small service is liable to produce equally undesirable effects upon the supply authorities. The expense attached to metering, both in initial cost and subsequent inspection and office expenses, is probably by far the greatest bugbear, and when these items are considered in relation to the actual power consumed, it is generally agreed that it is disproportionately heavy both for the consumer and the supply authority, which, of course, keeps up the price of the "juice."

The motor, mercury and induction types of meter are generally used and represent quite a considerable outlay; the electrolytic meter is cheaper, but is not looked upon with a great deal of favour on account of past sins. With a modern meter, however, a large part of the obstacle is prejudice.

The fixed-charge system is cheap for the supply authorities, and results automatically in a lowering of the price of the energy, but is unsatisfactory and unscientific, and is apt to lead to extravagance owing to there being no limit to the current consumption.

Current-limiting devices of a sort have been put into operation with mixed results. Some of them require too much resetting, while others require too much *a fortiori* reasoning in addition to a possible gift of clairvoyancy. A reliable current-limiting device, which must be inexpensive, would eliminate the cost of the meter and also a deal of administration expense. The ideal apparatus for this purpose would probably fulfil the following conditions:—(1) It must be cheap; (2) it must be reliable; (3) it must automatically prevent the current consumption exceeding a fixed value and, upon the excess load being removed, it must come into the reset position quite automatically; (4) and lastly, it must cause no appreciable loss.

To fulfil these conditions, the use of condensers has been suggested, and upon comparing a current-limiting condenser with the conditions outlined above, it will be found to slip most comfortably into position.

A condenser used for this purpose can be coupled into circuit in two ways; either in series with the whole system, or alternatively, each condenser and light run as a separate unit. Parallel operation of the lighting, which necessitates a separate condenser for each light, is not so suitable for the purpose, taking all into consideration, but the series system of coupling up presents many advantages for such small loads as are likely to be met with under the heading of domestic load.

With the parallel system each lamp is supplied from the distribution board in the usual manner except that it is connected in series with a condenser. The condenser used must be chosen with due regard to the consumption of the lamp, and the voltage across the mains will be split up across the condenser and the lamp; in other words, making up a circuit containing capacity and resistance to which the law: $C = E/R$ applies. The drop across the condenser is considerable, but the two components of the circuit are 90° apart, the condenser current leading by the maximum angle so that no appreciable loss takes place.

With one size of condenser, a variety of different candle-power lamps can be used, but the current consumption must be the same in every case, so that to get the correct wattage, and consequently candle-power, the lamp resistance must be increased as more light is wanted; in other words, a higher-voltage lamp must be used. Thus, assuming a condenser designed normally to pass ½ A to get 30 c.p. a 60-V lamp must be used. A 15-c.p. lamp would have to be rated to operate at 30 V; for 10 c.p. a 20-V lamp would be required, and so on right down to the lowest voltage. It is even feasible to use a 4-V 2-c.p. lamp in this way.

There is, however, no very great advantage to be obtained with the parallel system, except that as lower voltage lamps are used the lamp costs are less. Further, the candle-power required can be very accurately supplied so that there is no need to use a lamp of higher candle-power than is necessary, as is very often the case with high-voltage lamps.

The series system is that which would prove most useful. In this case all the lamps are connected in series and in series with a condenser, the capacity of the latter being such that on a short circuit on its own terminals it will pass the maximum allowable load for any particular consumer. Each lamp or point is controlled by a switch connected *across* the terminals, so that the apparatus can be short-circuited. If any particular light is required, the switch is moved to the open circuit position; to put the light out again it is short-circuited.

Any number of lamps of any desired candle-power can be used, provided that they are all of the same current consumption, and that the sum of their voltages does not exceed more than about 40 per cent. of the supply voltage. For instance, assuming a 240-volt supply, a 1-A circuit could be adopted, and the lighting could be made up on the following lines:—Four lights could be used as 8 c.p., 8 volts; 12 c.p., 12 volts; 16 c.p., 16 volts; 32 c.p., 32 volts.

Further lamps could be connected up to a total of 100 c.p., but the current consumption must in each case be the same; any number of lights can be alight at one time, or all can be out together. If the 40 per cent. value is exceeded, the voltage variation across the lamps will vary to an undesirable extent from a minimum when all lamps are alight to a maximum when only one is alight. An arrangement of lamps like this would impose a limit of 1 A consumption upon any consumer, and any attempt at taking more by interfering with the wiring would only result in the diminution of the total candle power. The substitution of a lamp of greater current consumption in any particular holder would upset the balance of the group, and would only result in a decreased light.

The cost of the condenser is very little, and decreases with an increase in frequency. The circuit conditions are such that a leading current is always taken from the mains, which will usually be looked upon as an advantage, as it will counteract the lagging current due to induction motors, transformers, &c., and result in a tendency to level up the power factor towards unity.

Assuming all lamps to be alight, the circuit consists of a capacity and resistance in series, when the power factor will probably be in the neighbourhood of 0·5 per cent. leading. As lamps are switched out by short-circuiting them, the angle of lead will increase until, when all lamps are out, 90° is reached.

The calculations involved are quite straightforward. The voltages across the condenser, resistance (lamps), and across the two together are connected together as follows:—When the supply voltage $= E_s$; condenser voltage $= E_k$; lamp voltage $= E_r$; then $E_s^2 = E_k^2 + E_r^2$. The lamp voltage and supply voltage being known, the voltage across the

condenser will then be $E_k = \sqrt{E_s^2 - E_r^2}$. The capacity of the condenser will be $K = 1/2\pi f E_k$, when I is the normal current consumption, f = supply frequency, and E_k is the condenser voltage calculated from the previous equation. The current variation between the limits of one and all lamps alight can be obtained from the equation $I = E_s/\sqrt{E_r^2 + [1/2\pi fK]^2}$, where E_r is the total rated voltage of the lamp or lamps connected in series.

HIGHLAND HYDRO-ELECTRIC SCHEMES.

IN an article contributed to a recent issue of the *Glasgow Herald*, Mr. A. Newlands, engineer-in-chief, Highland Railway Co., dealt very fully with the work to be undertaken in connection with the two large hydro-electric schemes in which the highland lochs are to be employed.

The first of these schemes is that formulated by the British Aluminium Co. in its Lochaber Water Order. The plans of this company provide for the conversion of Lochs Laggan and Trigg into storage reservoirs. Loch Laggan is about seven miles long by an average width of half a mile. It has a superficial area of about 1,900 acres or three square miles, and its height above sea level is 819 feet. Loch Treig is approximately five miles long by half a mile wide, has a surface area of 1,500 acres, and stands 784 feet above sea level.

The scheme provides for an extension of Loch Laggan at its western end by the construction of a dam 26 ft. high across the Spean about half a mile from its outlet from the loch. The level of the loch is not to be raised. Loch Treig is to be raised 35 ft., *i.e.*, to the level of Loch Laggan, and the two lochs are to be connected together by a tunnel three and three-quarter miles long, so that they will together form one great reservoir. Powers are asked to run down Loch Treig 124 ft., and Loch Laggan may be run down about 20 ft.

The drainage area of Loch Laggan is to be supplemented by diverting into it the flood waters of the Spey, the Markie, and the Mashie, which at present flow to the river Spey. This involves the building of a dam 29 ft. high below the junction of the Markie with the Spey. All the waters of the Treig are to be utilised, as are also the waters of the Spean, with the exception of those flowing into it from the north, between its junction with the river Treig and the sea. From Loch Treig a tunnel 15 miles in length on an easy gradient of about 1 in 2,000 under the north shoulder of Ben Nevis will convey the waters of the combined lochs to a point overlooking Loch Linnhe, where they will be delivered to a generating station one and a quarter miles distant, to be built in the "Black Park" on the shore at Loch Linnhe near Ben Nevis Distillery. This tunnel will pass under the streams flowing off the north face of Ben Nevis, and the waters of these streams will enter the tunnel by way of vertical shafts.

A diversion one and a quarter miles in length of the West Highland Railway at Loch Treig is involved, and also powers to supply and sell electricity to outside authorities and persons are asked for.

The other scheme is contained in the Grampian Electricity Supply Order, which is to be presented to Parliament during the forthcoming session. In this scheme it is proposed to utilise Lochs Ericht and Garry in Perthshire, and Lochs Pattack, Cuaich, and Seilich in Inverness-shire as storage reservoirs. The most important of these lochs is Loch Ericht. It is 14¼ miles long by an average of half a mile wide. Its surface area is approximately seven and a quarter square miles, and its height on ordnance datum is 1,153 ft. Loch Garry is two and a half miles long by quarter of a mile wide, and stands at an elevation of 1,359 ft. The others are smaller, but some of them stand at greater elevation, the levels of Loch Seilich being 1,390, Cuaich 1,302, and Pattack 1,386. Loch an Duin on the county boundary between Inverness and Perth is a small loch about 100 acres in extent at an elevation of 1,590 ft.

It is proposed to raise Loch Ericht 57 ft., *i.e.*, to 1,210 on ordnance datum, by damming it at each end, and the new water level will be such as would permit any overflow water to cross the water shed at Dalwhinnie and flow to the Truim and thence to the Spey, and there is physiographical evidence to show that in ancient times Loch Ericht actually did discharge into the Spey. In the present scheme, however, overflow waters will be made to flow into the Ericht as at present. Loch Pattack is to be raised 29 ft. by damming its existing outlet, and, by means of a tunnel, made to discharge the waters of its gathering area—and others led into it—into Loch Ericht; Loch Seilich is to be raised 55 ft. by a dam 110 ft. high some distance from its outlet, but Loch Cuaich is not to be raised.

Loch Garry is to be raised 71 ft. by a dam 79 ft. high, and the impounded waters are to be led in a tunnel along the southern slope of the Grampian range of mountains which extends eastward from Dalnaspidal to a point in Glen Bruar between Struan and Blair Atholl, where a reservoir is to be constructed by building a dam 107 ft. high across the river, from which reservoir the water will be delivered to a generating station to be built on the banks of the River Garry near the west lodge to Blair Castle at an elevation of approximately 450 ft. The waters of all the streams discharging into the river Garry from the east will be intercepted and stored in reservoirs built on each of them and delivered into the tunnel referred to through vertical shafts in the same way as is proposed for the Lochaber scheme. The surface levels of all these reservoirs, from Loch Garry to and including Bruar reservoir, are to be at the same level as Loch Garry, viz., 1,430 ft. on ordnance survey datum. A high-level reservoir having a surface level of 1,750 ft. is also to be constructed by an enlargement of Loch Mhuire on the river Tarf, a tributary of the Tilt. The construction of this reservoir involves the building of three dams 66, 89, and 130 ft. high respectively. Various streams rising on the Grampian watershed will be led into this reservoir, the combined waters of which will be led to a generating station on the Bruar reservoir, into which the tail race will discharge.

The total length of tunnelling involved is approximately 30 miles.

Provision is made for five generating stations:—

(*a*) On the shores of Loch Rannoch at the mouth of the river Ericht. This will deal with the water impounded in Loch Ericht.

(*b*) On the shore of Loch Ericht where the waters from Pattack enter the loch.

(*c*) On Loch Cuaich where the waters collected in and near to Loch Seilich are delivered into Loch Cuaich. This water after passing through the turbines is to be conveyed into Loch Ericht.

(*d*) On the Bruar reservoir already referred to.

(*e*) Near West Lodge, Blair Castle, already referred to.

An interesting engineering feature of these schemes is the adoption of pressure tunnels as aqueducts in place of open flumes. The construction of these tunnels will involve the sinking of shafts into them in order that work may be engaged in simultaneously at many points. The route is so arranged that these shafts can be sunk from the beds of streams crossing over the tunnel, and the gradient of the tunnels is such that the open mouths of the shafts will be at a higher level than that of the reservoir from which the tunnel starts.

In this way the full head of water between the reservoir and the turbines can be maintained without loss—beyond frictional loss—and flood water as well as the ordinary run-off of the streams can be taken into the tunnel as desired, thus conserving the stored water in the reservoirs against dry spells.

It will be noted that there is some overlapping in the claims of the promoters. The Lochaber scheme is confined to the county of Inverness, but contemplates diverting part of the waters of the Spey Basin into the Spean. The promoters of the Grampians scheme, which is a public utility project, seek constructional powers in the counties of Inverness and Perth, and powers to distribute and sell energy in an area of supply which includes part of the county of Inverness, viz., the parishes of Kingussie and Inch and Laggan, the whole of the counties of Perth, Kinross, and Forfar, the parishes of Lismore and Appin in Argyllshire, and certain parishes in Stirlingshire as far south as Kirkintilloch. Their proposals also involve the diversion of the waters in and around Loch Pattack from the Spean—Lochaber's scheme—to the Tay Basin, and they also wish to divert part of the waters of the Truim and the Tromie, tributaries of the Spey, into Loch Ericht and thence to the Tay.

There will very probably be opposition to these proposals to divert water from its natural gathering area into another area, and the County Council of Inverness has already decided to lodge objection to the schemes on these grounds. At this stage such opposition is more or less formal, and is for the purpose of securing a locus in order that protective clauses may be got when the hearing before committee takes place. It is very probable that similar objections may be lodged by other bodies for the same reason.

The power derived from the Lochaber scheme will, of course, be devoted principally to the purposes of the British Aluminium Co. The aims of the promoters of the Grampian scheme are indicated in their application. They are to be a public utility company, and their area of supply is defined in their application. It is popularly believed that Dundee, Perth, and other towns will provide an already existing market for the power, but, as in the case of the Lochaber scheme, local interests within the "area of origin" will doubtless see to it that reservation of such a block of power as is necessary for the development of their territory is secured.

Spanish Electrical Developments.—According to recent statistics, the total power yielded by existing installations in Spain is as follows:—Installations of 800 h.p. and above, 577,192; installations of 300 to 800 h.p., 28,162; installations of less than 300 h.p., 13,402—or a gross total of 618,756. Installations in course of construction, not reckoning those below 5,000 h.p., stand for 259,000 h.p., and applications for fresh concessions are always numerous. The total before the war was only 150,000 h.p.

E

JOINT ELECTRICITY AUTHORITIES.

WE recently abstracted the leading particulars of the first scheme that has been formulated for the formation of a Joint Electricity Authority for the purposes of the Electricity (Supply) Act, 1919, namely, that referring to the West of England District.* A number of other schemes have now been prepared, but as they had not, at the date at which they had to be submitted to the Electricity Commissioners, been considered by some of the local authorities concerned, we are not at liberty to publish details thereof. Two schemes, however, are excepted, and they are abstracted hereunder. It will be seen that in the main they are somewhat similar to what may be termed the Bristol scheme, although they differ in one important respect; that is to say, in addition to the administrative and financial organisations to be adopted, technical proposals are also outlined. In what follows we shall only deal with those portions of the schemes which differ from the provisions of that proposed for the Bristol area.

MERSEY AND WEST LANCASHIRE SCHEME.

The scheme referring to this area (see our issue of July 23rd, p. 106) provides that members of the Joint Authority who shall be appointed or elected by local authorities shall be entitled when attending the meetings of the Joint Authority or the committees thereof to be accompanied by one official of the local authority by whom such member shall be appointed, or in the case of members elected by more than one local authority, by one official of one of the local authorities taking part in the election, such official to be selected by the member and shall not be entitled to vote, but in other respects may take part in the proceedings as if he were a member of the Joint Authority.

The Joint Authority may provide, let for hire, manufacture, sell, or otherwise deal in electric lines, fittings, apparatus and appliances for lighting, heating and motive power, and for all other purposes for which electricity can or may be used, and may connect, repair, maintain, and remove the same, and with respect thereto may demand or take such remuneration or rents and charges and make such terms and conditions as may be agreed upon between the Joint Authority and the person, company, or firm to or for whom the same are sold, supplied, let, connected, repaired, maintained, or removed.

The Joint Authority shall provide for the supply of areas not forming part of the area of supply of any authorised undertakers, either by including such areas in the district of adjoining distributors or supplying such areas direct, or in such other manner as they may with the approval of the Commissioners determine.

The Joint Authority, when formed, will proceed in stages, the first stage will be to interlink the generating stations of the authorised undertakers for the following county boroughs, viz.: Bootle, Birkenhead, Liverpool, St. Helens, Wallasey, Warrington. From this combination, extensions will be carried out when necessity arises. At a later stage it is proposed to link up the Joint Authority's undertaking with the United Alkali Co., the Mersey Power Co., and through the area now supplied by the Mersey Power Co., with Ellesmere Port, and thence through Birkenhead to a junction with the mains running from Liverpool to the Cheshire side of the river Mersey.

The system of supply to be adopted will be 3-phase, a.c., 50 periods. The main transmission pressure suggested is 33,000 volts stepped up from the generated pressure, which at the present time is in the majority of the stations 6,600 volts. An immediate pressure may be required on certain routes, but the necessity for it has not yet arisen. A list of the proposed transmission mains is given.

Ultimately a connection will be made between Prescot and the Mersey Power Co. when development of the load warrants it. It will also be necessary to provide for transformers, and a list of them, together with the necessary switchgear is set out. The Joint Authority will link up the main generating stations in the area referred to above with 33,000-volt mains, and as the load develops in other areas extensions to those areas will be made.

The following extensions of plant in connection with the main generating stations referred to are in course of construction: St. Helens, one 5,000-kW; Warrington, two 6,000-kW; Liverpool, two 12,500-kW; Wallasey, one 5,000-kW sets.

Until the new proposed capital station is running, all the existing stations will be required, but eventually certain of the stations will be shut down. The Joint Authority proposes that a new capital generating station should be installed in Liverpool on the riverside. Electrical energy will be generated at 6,600 V, 3-phase, 50 periods, with step-up transformation to 33,000 V for main transmission.

The maximum load estimated for the year 1925 for the main generating stations included above is 155,000 kW and the maximum load that can be provided for in 1925 by the individual undertakings with the extensions at present sanctioned will be 87,000 kW, a difference of 68,000 kW, which will have to be provided for the winter of 1925. The Joint Authority proposes to instal in the new capital generating station four 25,000-kW turbo alternator sets, which will provide one 25,000-kW set as spare. In the existing generating stations, when the proposed extensions are completed, it is estimated there will be 29,000-kW of spare generating plant installed, a total of spare generating plant available of 54,000 kW.

It is proposed to apply to the Ministry of Transport to proceed forthwith with the erection and equipment of the first section of the new capital generating station. The scheme will be capable of providing for railway and tramway requirements as and when the demand arises.

THE WIRRAL SCHEME.

This scheme is to be submitted in opposition to the above-mentioned one, and it is proposed to include in it only the south-western portion of the area already delimited by the Commissioners, comprising the county boroughs of Birkenhead and Wallasey, the urban districts of Bromborough, Higher Bebington, Hoylake and West Kirby, Lower Bebington, Neston and Parkgate, and the rural district of Wirral.

In this case it is provided that the Joint Authority shall consist of only 18 members of whom 11 are to be appointed by the local authorities specified above; one each by Caldy Manor Estate, Ltd., Mersey Docks and Harbour Board, Cammel, Laird & Co., Ltd., Lever Bros., Ltd., railway companies using electricity, and two by other large consumers than those specified above.

This scheme assumes a large consumer to be a person, firm, or company whose consumption exceeded 100,000 units during the year preceding the date of the election.

As in the case of the Mersey scheme, certain of the provisions made in the Wirral scheme differ from those proposed for the Bristol district, but conform to those made in the Mersey scheme, especially with regard to the technical provisions. At the Wallasey generating station an extension of one 5,000-kW set is in course of construction. The maximum loads estimated for the year 1925 for the stations included in the area are: Birkenhead, 11,000; Wallasey, 12,000; Hoylake and West Kirby, 750; a total of 23,750 kW. The maximum load that can be provided for in 1925 by the individual undertakings with the extensions at present sanctioned will be 10,000 kW, a deficiency of 13,750 kW. It is, therefore, proposed to install in the Wallasey station three more 10,000-kW sets with boilers, condensing plant, and switchgear complete.

The saving that it is estimated will be effected by the proposed scheme is that if the 6,300,000 units sold by the Birkenhead Corporation in 1919 were generated at the proposed Wallasey station there would be a saving of £11,450 per annum in generating costs. The cost of cables would be approximately £30,000 or, say, an annual cost of £3,000, showing a saving of £8,450 per annum. The district of Hoylake and West Kirby is about six miles from the Wallasey generating station. If the 600,000 units sold by the Hoylake and West Kirby District Council, in 1919, were generated at the proposed Wallasey station there would be a saving of £2,500 per anum in generating costs. The cost of cables would be approximately £12,000 or, say, an annual cost of £1,200, showing a saving of £1,300, which, added to the aforesaid sum of £8,450, shows a total saving of £9,750 per annum.

* ELEC. REV., December 24th, 1920, p. 809.

WIRELESS RECEPTION BY TASTE PERCEPTION.

PRACTICALLY all reception of wireless telegraph signals of a practical nature which has been done up to the present time has been accomplished by means of the sense of hearing of the operator. Attempts have been made to use the sense of sight for the purpose, but it has not been found sufficiently satisfactory to warrant its use in practice. The object of a paper recently presented to the Institute of Radio Engineers, New York, by Messrs. A. N. Goldsmith and E. T. Dickey was to describe the tests made to determine the feasibility of Mr. A. A. Isbell's suggestion that under certain operating conditions, *i.e.*, great interference due to external noise, it might be advantageous to employ the operator's sense of taste for receiving wireless telegraph signals. For the following abstract of the results obtained we are indebted to the *T. & T. Age*.

That a stinging sensation is produced when the two wires of a low potential electric circuit are placed on the tongue is a well-known fact. The first problem, then, was to design a pair of electrodes which could be kept in the operator's mouth for a considerable time, and which would not form injurious metal salts. Tests were made to determine the best position, pressure, and size of contact for the electrodes, and it was found that when using either d.c. or 60-cycle a.c. it was better to have the electrodes slipped over the upper front teeth, rather than to place the tongue between them. In this position one contact touched the inner part of the upper lip, while the other could be conveniently touched by the tip of the tongue.

When using signals from a buzzer source, and antenna, the arrangement just described was apt to cause painful sensations in the operator's front teeth. In an effort to prevent this, a disposition having the ends of both contacts touching the tip of the tongue gave very good results. The electrodes should be small and close together so as to confine the taste

sensation to a small area of the tongue. Two pieces of number 16 silver wire 0.5 in. (1.27 cm.) long, separated about 0.125 in. (0.31 cm.) and partially embedded in some insulating material make very satisfactory electrodes for actual signal reception.

The highest speed which the operator found it possible to receive by taste reception was five words per minute, and in order to do this it was necessary to become accustomed to this method of receiving, for it is quite dissimilar to audio-reception. It is possible that with sufficient practice an operator might be able to receive at a rate of ten words per minute by taste reception. It is doubtful, however, if the speed could be increased much above that. The reason for this is what might be called the " lag " of the taste nerves.

In the tests using d.c. and 60-cycle a.c. it was found that about 2 volts potential was necessary for workable taste signals. The measurements made with d.c. indicated that this potential produced a current of about 0.25 milliampere in the mouth electrode circuit. In other words, the energy necessary for readable taste signals was about 500 micro-watts.

For receiving outside signals, an ordinary inductively coupled vacuum tube receiver was employed. The antenna used was a single wire, 150 ft. high and 180 ft. long.

With four stages of amplification it was possible to get taste sensations from all signals, the audibility of which in the detector circuit was 500 or more. The higher the audibility of the signal, the stronger was the taste sensation produced. The strongest signal received had an audibility of 5,000 in the detector circuit. The taste sensations resulting from this signal were not strong enough to cause discomfort for the operator. Whether or not a signal might be obtained of sufficient intensity to cause discomfort to the operator, would depend on the amount of energy which the last stage of the amplifier could handle.

As the signals received were commercial messages, their speed prevented them from being read by taste reception, but the intensity was sufficient to permit of their having been read had the sending been slower. It would be impossible to read through interference with the taste receiver unless one signal was quite strong and the other almost unnoticeable. Strong strays would probably cause signals to become unreadable.

From the point of view of electrical operation, taste reception is possible. It is possible to amplify sufficiently a signal having an audibility of 500 in the detertor circuit to cause it to produce taste sensations. It is possible to read signals by the sense of taste if they are sent at a low speed (about five to ten words per minute).

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

German Competition in the Electrical Trades.

I certainly have not overlooked any of the facts affecting the isoperimetrical problem which Messrs. E. P. Allam & Co. have evidently not studied seriously, as yet; and it is conceivable that their determination to refuse German offers—" not touch them with the end of a barge pole "—may have something to do with " the daily processions of the unemployed."

Let us try to get at the *truth*, and avoid all personal remarks. Will Messrs. E. P. Allam & Co. kindly say :—

1. How can Germany pay her war-debts to this country except by sending us goods?
2. Is it not a fact that the cheaper the goods the greater the quantity that must be sent?
3. Do " Rings " " enable the home buyer to have cheap goods, and, at the same time, enable the manufacturer to compete successfully in the world's markets "?
4. If " dumping " ruins this country, why do we not dump in self-defence?

W. H. M.

January 1st, 1921.

We should also like to tender our thanks to you for your leading article on this subject, and to endorse all that Messrs. E. P. Allam & Co. say in their letter in your issue of December 31st.

We wonder if " W. H. M." is a merchant or manufacturer—if the latter, we should be very interested to hear his views as to how he would meet the German competition, assuming that he is producing his goods with modern high-speed machinery and a thoroughly conscientious and hard working set of employés, and that after he has done all possible to reduce costs, he still finds these dumped German goods are being sold in this country at very much less than the cost of production here.

It would seem, according to " W. H. M.'s " letter, that we must thank Heaven that our trade is being destroyed and our country flooded with cheap German goods, that millions of pounds' worth of valuable new machinery is absolutely idle, and that hundreds of thousands of our workers are walking the streets starving and out of work, whilst the Hun dumps his finished goods into our free market, adds to our unemployed in this country and contributes nothing towards relieving our taxation.

All British.

A Generator Problem.

I am indebted to Mr. Robertson and Mr. Besley for their letters on the above in this week's REVIEW. I have not tried the voltage across the shunt field as Mr. Robertson suggests, but will do so at the earliest opportunity. The fields of the motor and of the generator are connected N to N and S to S; if these connections are reversed, it is only possible to get 25 per cent. of the full rating.

The compound is not connected to the series winding as is usual with self-exciting machines, but is practically only a lead from the armature to the terminal box, with the usual windings around the field; the same results in every way can be obtained by disconnecting the compound and having a lead direct from the armature to the terminal box, hence my question : What is the reason for the compound winding? I quite agree with Mr. Robertson that " the compound winding is for the purpose of regulating the voltage under varying loads " if this machine was self-exciting. It being connected for separate excitation, it is impossible to cut out or short-circuit the series winding as Mr. Robertson suggests.

Several days were spent in testing by myself, another firm of electrical engineers, and also the engineer called in by our customer, so I am satisfied that the connections are correct. I am of the same opinion as Mr. Besley, that this machine is designed for separate excitation; why it will run as a motor and not as a generator is beyond me.

Wireman.

January 1st, 1921.

A Curious Phenomenon.

You will be interested to know, I feel sure, that shortly after the publication of my letter under the above heading, the Sectional (Leicester) Engineer of the Post Office telephone system sent one of his men to examine the earth wire of the Post Office telephone instrument fixed in my house, although the phenomenon in question occurs elsewhere.

I only give you this information to show how eagerly your paper is scanned through immediately it is published.

I also think that it is a feather in the cap of the sectional engineer, with whom personally I am unacquainted, and tends to show that Government officials are sometimes on the *qui-vive*, although sometimes we may assume the contrary to be the case.

I have not yet had time to carry out further experiments in this connection, but will do so at the first opportunity, and afterwards report the results to you.

J. Knowles Hassall.

Rotherwood.
January 1st, 1921.

The Cost of Living on the Gold Coast.

Will you kindly insert in your next issue (if possible) a few particulars regarding the Gold Coast? :—

Climate conditions throughout the year.

Cost of living, food, clothing, &c., and any other particulars available.

'Phone Engineer.

[We regret that we have no up-to-date information on this subject. We shall be glad to receive communications from any of our readers who possess a knowledge of the conditions obtaining on the Gold Coast.—EDS. ELEC. REV.]

To Correct an Impression.

Will you kindly permit us to make use of your columns for the purpose of correcting an impression which has gained ground to the effect that J. B. Saunders & Co., Ltd., have amalgamated with Twiss Electric Transmission, Ltd.? The incorporation covers the *transmission-line business only* of the former company. Otherwise J. B. Saunders & Co., Ltd., retain their individuality, and carry on their railway telegraph and telephone maintenance and construction business, as has been the case without interruption since 1857.

Sydney G. Leech.

London.
January 3rd, 1921.

Switches for Gasfilled Lamps.

We should be glad if any of your readers could give us information with regard to switches suitable for use with gas-filled lamps. Ordinary tumbler switches we have found unsatisfactory due to burning of the contacts. Rotary snap switches are difficult to get at the moment, and are also difficult to fix in a neat arrangement when mounted in groups of six or more together. We do not think there is any satisfactory box for groups of such switches when recessed for sunk work, or when mounted in iron boxes and covered with surface plates for factory work. We ourselves have not had

sufficient experience with clock make-and-break tumbler switches to say whether these are satisfactory or not. A few inquiries have led us to the conclusion that the same state of ignorance and doubt exists amongst other contractors, and we think personal reports, from anyone who has had experience, would be of general interest.

Tyler & Freeman.

London.
January 3rd, 1921.

Home Lighting Economies.

I think a warning should be given to any of your readers who may be tempted to adopt "Voltman's" suggestion, on page 827 of your current issue, for the economical illumination of inaccessible places and dark recesses. The flexible and the miniature switches and lamp holders usually associated with 4- or 6-volt lamps are quite unsuitable for connection to a 230-volt circuit, and it should be remembered that although the shunted circuit is only occasionally in actual use, it will always be alive to the full pressure. The recesses referred to are among the last places in which such unsatisfactory fittings should be permitted, and I would advise "Voltman" to remove every part of his economy extensions that is not strictly in accordance with the I.E.E. wiring rules, and to make a beginning with that dark cupboard under the wooden staircase which leads to his bedrooms.

There is a further fire risk due to the accumulator cells "boiling" nearly dry—for instance, when they are not regularly "topped up" or when the house has been closed for a week-end and the main charging lamp left alight. There are several recorded instances of fires due to the prolonged charging and overcharging of small celluloid cells.

It is feared that economies of the kind suggested are those that are often paid for a thousand-fold by other persons—in this case the fire insurance companies.

E. R.

January 3rd, 1921.

Re Home Lighting Economies in this week's Review, I should like to point out to "Voltman" that when tantalum lamps first came in I tested several large installations in order to prove to the owners the saving that could be effected by using these new lamps, and the average watts per candle with the carbon lamps in use were well over six.

If, as it would appear, "Voltman" is not particular about initial expense, why not fix a few 230-V m.f. lamps in series and use intermediate switches in each room? He could then light all his rooms at the cost of one lamp.

C. A. Copinger.

Bentham.
January 2nd, 1921.

Mr. Luckiesh and the Sheringham Daylight.

I shall be greatly obliged if (in the interests of fair comment) you will allow me to publish a few words on the extract you published in your last number from Mr. Luckiesh's letter (about my invention) to the *Electrical News* of Toronto.

In this letter Mr. Luckiesh has adopted a course, somewhat unusual among scientists, that is of passing judgment on my invention before he has had an opportunity of seeing and testing it. He refers in his letter to some unsuccessful experiments he made with reflectors seven years ago; his deductions about "the Sheringham Daylight" invention must be influenced by his own lack of success in the application of reflectors, as he has had no first-hand experience of my invention.

Of course, we all know and appreciate at its full value his development of the British transmission lamp, which was invented by Mr. Dufton and Prof. Gardiner at Bradford, about 1895, and which Mr. Luckiesh describes, no doubt scientifically, as "straightforward."

The "millions" of colour-matching units, which Mr. Luckiesh refers to, are, of course, lamps that do not attempt to reproduce north sky light, and he himself describes them as only "fairly efficient"—see *The Illuminating Engineer*, February, 1920.

George Sheringham.

London.
January 3rd, 1921.

The Salaries of Works Engineers.

Apropos of the remarks of your correspondent "Testbed, A.M.I.E.E.," in your December 24th issue, may I be allowed to inform him that the E.P.E.A. does already possess a section for works engineers?

If "Testbed" or any other engineer interested cares to communicate with me through you, Sirs (in the first instance), I shall be glad to give any information or assistance.

Industrial.

Norbury.
December 28th, 1920.

LEGAL.

Unemployment Insurance.

At Padiham, Messrs. Simpson Bros., electricians, Hapton, were proceeded against under the Unemployment Insurance Act. There were 16 cases. An inspector called at Messrs. Simpson's works and found 135 workpeople's unemployment insurance books in arrears. In eight instances the books were impounded.

Mr. Waddington explained that it was a matter of neglect on the part of a girl clerk. The stamps were purchased, but the clerk had neglected to put them in the books. That constituted the whole offence. Although Mr. Simpson offered to put the stamps on, the inspector declined to agree. Mr. Waddington complained that from September 8th till now the Ministry had detained the eight impounded books, thereby preventing the firm from stamping them.

Defendants were fined 25s. in the first case, and ordered to pay two guineas advocate's fee, and costs in the remainder. They were also ordered to make good the arrears of stamps.

WATER POWER ON THE CONTINENT

France.

As a result of the possibility of the world coal shortage hindering the re-establishment and development of the national industries, the French Government, shortly after the signing of the peace treaty, decided that it would be necessary to utilise on a greater scale than hitherto the water power resources of the country.

The problem being an extensive one, needing consideration from the technical and financial points of view, as well as the administrative one, a Commission was appointed in August 1919, to study the whole question and report to the Superior Council of Public Works. The report has now been presented, and although it is not possible to give it in full, the following points of detail taken from it, for which we are indebted to the *Moniteur des Intérêts Matériels*, may be of interest.

Naturally the question of finance comes in for early reference. Pre-war estimates put the cost of hydro-electric plant at from 500 to 800 fr. per H.P.; to-day the cost would be from 1,000 to 1,600 fr. per h.p. Therefore, to establish plant equal to 3,000,000 H.P., such as, it is considered, would be necessary to attain the desired object, would entail an expenditure of from 3,000,000,000 to 4,800,000,000 fr. The absence of a sufficient supply of materials is not so much feared as that the cost of plant at present prices would be prohibitive.

It is estimated that before the war over 1,000,000,000 fr. had been invested in hydro-electric plant in France—525 millions in light and power installations, 100 millions in electro-chemistry and electrometallurgy, 75 millions in traction, and 300 millions in connection with small industries. During the war and since the armistice, considerable progress has been made, plant to the extent of 500,000 H.P. having been put down between 1914 and 1918, so that at the present time at least 2,000,000,000 fr. must be invested in hydro-electric plant in France.

The Commission recommends that the formation of *concessionnaire* companies should be facilitated by the granting of subsidies, and that these should be a direct charge on the Government Budget, instead of the so-called subsidies on which the *concessionnaires* have to pay interest and make repayment over a term of years. The Commission considers that in this way the *concessionnaires* would be encouraged, as they would not have to bear a heavy financial load which could only result in an increased cost of production. The Commission also recommends that companies which undertake the establishment of hydro-electric plant should be exempted from taxation for a period of five years, and that the Government should arrange with the Crédit Foncier to advance loans in respect of the utilisation of all State and private waterfalls, and finally that the Government itself should participate in the formation of undertakings, sharing in the advantages, risks, and difficulties.

The report does not deal at any great length with the technical problems. It recommends, however, that steps should be taken to extend the teaching of electrical work in the Grenoble, Toulouse, and Nancy districts by subsidies from the State and the electrical industry. It also points out that one of the hindrances to the development of water power for electricity generation is the considerable variation in the supply of water, and suggests that if the Government cannot see its way to undertake the construction of large reservoirs itself, it should grant subsidies to the *concessionnaires* for this purpose.

The Commission takes the view that the public interests must be considered before those of private enterprise, and that legislation will be necessary to deal with existing concessions and any rights which may have been granted previously, while as regards the future, it recommends that no concessions be granted for hydro-electric installations which do not contribute to the useful extension of electricity supply.

HOLLAND AND NORWAY.

There are two countries which are working in the direction of becoming independent of foreign supplies of coal at the end of ten years from the present time, these being Holland and Norway. In the case of the former, it is expected that apart from the great electrical generation and distribution schemes which are proposed to be undertaken by a semi-State or public authority, the national deposits of coal will have been so far developed that no deliveries of coal will be required from other countries at the expiration of a decade. On the other hand, Norway, which under normal circumstances is compelled to import about 2,500,000 tons of coal per annum, hopes to be able to substitute electric power for most of this quantity, leaving only 800,000 tons of coal needed for shipping, for the production of carbide, and for domestic consumption, after the lapse of ten years. It is, moreover, reckoned that the latter quantity will be obtained from Spitzbergen, which is now vested in Norway, so that in 1930 the latter country will be independent of British and other coal.

The State Water Power and Electricity Administration has under consideration draft regulations and a scheme for the electrification of the country, and is also dealing with the question of the exportation of energy—and that, too, at a time when the existing hydro-electric and steam generating works are unable to meet the home demand. It is, therefore, contended that before thinking of exporting energy the inland requirements should first be satisfied, the needs of industry and agriculture be met, and the railways converted to electric traction, so as to be able to escape the enormous expenditure on imports of coal. It is suggested that practical men should be empowered to proceed to solve the problems of (1) utilising the existing hydro-electric works to the fullest extent and erecting new transmission lines; (2) the regulation of water courses and the installation of more machinery where falls are already in use; (3) the completion of extensions which have been in progress for a long time; and (4) the transformation to electrical working of the railways having the heaviest traffic to transport.

The A.S. Tyssefaldene two years ago offered to supply Christiania with 100,000 H.P. on certain terms, and by request the company has just made a fresh proposal, but the price per KW. delivered is now more than twice that offered in 1918, owing to the high cost of machinery which would have to be installed for the purpose. The Akerhaas County Council has approved an agreement with the Christiania Savings Bank approved an agreement with the Christiania Savings Bank under which the latter will advance to the former a loan of 20,000,000 kr. for the hydro-electric works at the Raanaas waterfalls in Glommen, which is involving a total expenditure of 45,000,000 kr., and is expected to be completed in the winter of 1921-22.

BUSINESS NOTES.

Company Liquidations. — ELECTRICAL ENGINEERING SOCIETY, LTD. (late Electrical and Mechanical Co-operative Trading Society, Ltd.), South Castle Street, Liverpool.—At a meeting of creditors held recently in Liverpool, the statement of affairs presented by Mr. A. J. Glass, liquidator, showed liabilities of £1,903, of which £1,522 was due to trade creditors, while the bank was interested for £159, and there were cash claims of £223. The assets were estimated to realise £897, from which had to be deducted £78 for preferential claims, leaving net assets of £819, or a deficiency as regarded the unsecured creditors of £1,085. The assets consisted of:—Cash in hand, £10; stock-in-trade, £162; work in progress, £50; fixtures and fittings, £20; book-debts, £681, expected to produce £624; and unpaid calls, £31. The liquidator further stated that the business carried on was commenced by a number of members of the Electrical Trades Union about the beginning of 1919. In June of the same year the Society was registered under the Industrial and Provident Societies Act. The deficiency shown in the statement of affairs was accounted for by losses up to January, 1920, £566; depreciation written off the assets, £106; preliminary expenses, £9; and loss since last January, £1,281. It appeared that difficulties had been encountered in raising capital from time to time, and loans had been received from members. Last August the Society tendered for, and obtained, a large contract with a local co-operative society. With the exception of that contract, the other work carried out during recent months had been small. The sales had recently fallen off owing to the shortage of stock. After discussing the position the creditors passed a resolution in favour of Mr. P. S. Booth, Liverpool, being appointed to act as a joint liquidator, while a committee of inspection of three of the principal creditors was also nominated.

DETINNING PROCESSES, LTD. — A meeting of creditors is called for February 3rd, at 41, Finsbury Square, E.C., to hear an account of the winding-up from the liquidator, Mr. H. C. Merrett.

ELECTRICAL INDUSTRIES, LTD.—A petition for the winding up has been presented to the High Court by Messrs. R. Johnston and Co., Ltd., of 92-3, Fore Street, E.C., and will be heard in London on January 18th.

PRITCHETT & GOLD AND ELECTRIC POWER STORAGE CO., LTD.—(Voluntary liquidation for the purpose of the sale of the undertaking to Pritchett & Gold and Electric Power Storage Co., Ltd.). Meeting of creditors, January 19th, at 50, Grosvenor Gardens, S.W. 1. Liquidator, Mr. A. W. Woodward.

Trade Announcements.—MESSRS. BECKETT & PARKER, electrical instrument manufacturers, of 157-9, Summer Lane, Birmingham, have appointed Messrs. Baxter & Caunter, Ltd., their agents for London, Eastern and Southern Counties. Full stocks of their specialities will be held at 219, Tottenham Court Road, W. 1, and rapid deliveries are assured of switchboard type instruments.

THE CHLORIDE ELECTRICAL STORAGE CO., LTD., have removed their London offices to 57, Victoria Street, S.W. 1. The telephone numbers, Victoria 442 and 445, remain unaltered.

THE DAWSON ELECTRICAL INSTALLATIONS, LTD., have commenced business at 7A, Henshaw Street, Oldham.

THE IMPERIAL ELECTRIC WORKS will in future (as from January 1st) be known as Browning's Electric Co., Imperial Works, St. Martin's Avenue, East Ham, London, E. 6. Telephone, East Ham 801.

Catalogues and Lists.—THE MACFARLANE ENGINEERING CO., LTD., Netherlee Road, Cathcart. — Detailed price-lists of motors—d.c. and a.c. squirrel-cage and slip-ring types—for 25 and 50 cycles. Also a list of principal users of Macfarlane motors and dynamos.

SIR W. G. ARMSTRONG, WHITWORTH & CO., LTD., 8, Great George Street Westminster, S.W. 1.—Leaflets Nos. 51 52, 53, and 54 illustrating and describing water turbines. Leaflet 51 bears a number of useful notes on turbine and site selection, which we reproduce in our "Notes" columns.

HIGGS BROS., Sand Pits, Birmingham.—"Monthly Magazine," Vol. II, No. 10, containing the usual stock list and other features, including notes on the care of windings.

THE ELECTRIC HEATING CO., George Street, Croydon.—An illustrated price-list of "Elect" irons.

R. B. HAND & CO., LTD., 63, High Holborn, W.C. 1.—A price-list (4 pp.) of electrical fittings and accessories, including cables, conduits, switches, cut-outs, adapters, &c.

CHARLES CHURCHILL & CO., LTD., 9-15, Leonard Street, Finsbury, E.C. 2.—An illustrated and priced booklet (72 pp.) dealing with numerous types of "Comet" brand high-speed steel cutters.

OZONAIR, LTD., 96, Victoria Street, S.W. 1.—Pamphlet No. 3—Ventilation. An illustrated note on ozone and its properties, ventilation, and the "Ozonair" system of pure-air ventilation.

THE BRITISH RAWHIDE BELTING CO., LTD., Hythe Road, Willesden, N.W. 10.—List "A," giving prices and particulars of various beltings, belt laces, rawhide hydraulic packing, mallets, hammers, pinions, &c.

SCIENTIFIC APPLIANCES, 11 and 29, Sicilian Avenue, Southampton Row, W.C. 1.—An illustrated catalogue (48 pp.) of scientific apparatus, including Wimshurst machines of a wide range of sizes, electromagnets and parts, telephone apparatus, induction coils and X-ray tubes. Also optical apparatus, comprising spectacles, telescopes, lenses and prisms. Suitable for the use of students or teachers. Price 6d. post free.

T. BATH & CO., LTD., 18, Savoy Street Strand, W.C. 2.—A sale catalogue of wooden buildings, Army huts, &c.

N. TAYLOR & SON, 17, Goree-Piazzas, Liverpool, manufacturers of hydro-carbonate bone-black for case-hardening. A booklet (18 pp.) entitled "Case Hardening—What to Use. How to Do It."

THE B.E. CO. (OF LONDON AND BIRMINGHAM), LTD., Hendon House, 57, Upper Thames Street, E.C. 4. — A fully-illustrated catalogue (18 pp.) of electrical accessories, including switches, ceiling roses, adapters, cut-outs, fuseboards, "flex," &c. Code numbers are given in each case, and a key accompanies the catalogue.

X-RAYS, LTD., 11, Torrington Place, Gower Street, W.C. 1.—A priced descriptive catalogue (16 pp.) of Phillips's X-ray tubes of various types—water-cooled, heavy anode, platinum and tungsten targets, &c.

STERLING TELEPHONE AND ELECTRIC CO., LTD., Telephone House, 210-212, Tottenham Court Road, W. 1. Publication No. 285. —A profusely illustrated price list (32 pp.) of telephone and signalling apparatus for mines, including telephone instruments, junction boxes, indicators, bells, storage cells, &c.

THE DELTA ELECTRICAL CO., Temple Courts, Temple Row, Birmingham. Publication No. 100A.—An illustrated and priced leaflet dealing with watertight tumbler switches.

Calendars, &c.—MESSRS. A. HAWKINS & SON, of London Road, Southwark, have again issued one of their wall calendars, with monthly date slips below a picture showing a skein of thread which a lady is winding, with the wording "Held by a thread."

From MR. P. D. MORRIS, electrical engineer and contractor, 28, High Street, Islington, N., we have received a polished wood hand blotter and a piece of rubber.

MESSRS. J. MCMASTER & SON, Belfast, have produced an artistic wall calendar, with monthly slips for 1921 below a rustic picture of a mill, entitled "The White Mill."

MESSRS. WOOD & CAIRNS, LTD., 5, 7 and 9, Meuse Lane, Edinburgh, have sent us one of their large wall calendars, with monthly date slips with bold figures on a black ground, each slip showing views of the firm's head office and Glasgow and Dundee branches.

THE WESTINGHOUSE ELECTRIC INTERNATIONAL CO., of New York, have prepared a large wall calendar, with monthly date slips on a white ground below a reproduction of a painting of the head and shoulders of a lady named "Joan."

THE KEIGHLEY GAS AND OIL ENGINE CO, LTD, have sent us one of their wall calendars for 1921, with daily slips with figuring in black mounted on a stout card-base model of one of their "Imperial" engines.

THE HOLLAND INSULATED WIRE AND CABLE WORKS, Amsterdam, have sent us a four-sheet calendar bearing rather fantastic black and gold studies of Grecian mythological characters symbolising light, sound, power and heat.

E. BROOK, LTD., of Empress Works, Huddersfield, have issued an attractive hanging calendar, with monthly date slips below a coloured view of their works at night.

C. ISLER & CO., artesian well engineers, Bear Lane, Southwark Street, have sent us a large wall calender, with illustrations showing their deep-well boring plant and other specialities.

THE BRITISH THOMSON-HOUSTON CO., LTD., of Rugby, have again provided one of their large wall calendars for 1921, showing three months on each page, with a view of the works and illustrations of some of their special electrical plant.

MACINTOSH CABLES, LTD., have issued a neat hanging oval calendar for 1921, with monthly slips below a picture entitled "Peace at Eventide."

From the MODERN BUSINESS AND EQUIPMENT CO., of 31, Staines Road, Hounslow, a small hanging calendar, with monthly slips below a coloured illustration of "A Bit of Surrey."

Annual Dinner.—On Tuesday, December 28th, the employés of the Musselburgh and District Electric Light and Traction Co., Ltd., held their annual dinner at the Port Seton Tea Rooms. Mr. H. C. Babb, the engineer and manager, was in the chair. During the evening a presentation was made to Mr. H. Payn, the chief assistant engineer, who is shortly leaving to take up another appointment as engineer and manager. This was followed by a musical programme and dancing.

Book Notices.—"A souvenir of the 25th anniversary of *The Autocar*, 1895-1920" (8 pp. + 4 plates).—The remarkable progress that has taken place in the world of motoring during the past quarter of a century is brought vividly to mind by the appearance of this handsome souvenir booklet. The part played by *The Autocar* in the development of automobilism is briefly outlined in the booklet, which contains also a number of historical motoring illustrations reprinted from early issues of the journal. One of these depicts the first motor drive of the late King Edward VII (then Prince of Wales), which took place in 1898. Other illustrations show the famous Gordon-Bennett Motor Race in Ireland in 1903, and the first of the Tourist Trophy Races, which was run in the Isle of Man in 1905. A number of the pages in the booklet are devoted to a reprint of congratulatory messages received on the occasion of the 25th birthday of *The Autocar*. These bear names that are famous in the annals of motoring, including such well-known pioneers of motoring as Sir David Salomons, Bt., Lord Montagu of Beaulieu, Earl Russell, Sir Arthur Stanley, &c. Not the least attractive feature of the souvenir is a pair of illustrations in colour reproduced from original paintings and depicting 20 years' progress in automobilism.

"The M. & C. Apprentices' Magazine," Vol. 4, No. 16 (76 pp.).—This is the Christmas number of this excellent little publication. Mr. Sam Mavor contributes a long article on "Efficiency in Production"; other articles are notes on railway engineering in the United Provinces, India, "Electrical Engineering in the East," and a number of biographical sketches, &c.

"Hydro-Electric Survey of India, Vol. II. Second Report on the Water Power Resources of India. Ascertained during the season 1919-20." By F. E. Bull and J. W. Meares, M.Inst.C.E., &c. (123 pp.). Calcutta: Superintendent Government Printing, India. Price R. 1-6.

"The Industrial League and Council *Journal*," Vol. II, No. 11. December, 1920, 40 pp. Price 6d.—This issue contains a foreword by Dr. Russell Wakefield, Bishop of Birmingham, reports of meetings, conferences, debates, &c., as well as a number of interesting articles.

"Science Abstracts A & B." Vol. XXIII, part 12, December 30th, 1920. London: E. & F. N. Spon, Ltd. Price 2s. 6d. each.

"Oscillographs and their Tests." (45 pp.) By A. E. Kennelly, R. N. Hunter, and A. A. Prior. Massachusetts: Institute of Technology (Serial No. 22).—A technical description of a method of testing and calibrating oscillographs, using an auxiliary vibrator or "oscillographmeter," whereby the resonant frequency of the tested oscillograph may be readily ascertained. From this and another test the bluntness of resonance is determined. The results of a number of tests are given in the paper.

"Willing's Press Guide"—issued from 125, Strand, at 2s.—is a most convenient alphabetical and classified guide to the Press. That it meets a real want is evidenced by the fact that it has now reached its forty-eighth annual appearance.

"Dental Radiography" (38 pp.) Stratford: Wilson & Whitworth, Ltd. Price 3s. 6d. net.—A handbook for the dental surgeon, including a full description of X-ray apparatus and a simple guide to its use, with diagrams and many illustrations.

"The *Journal* of the South African Institution of Engineers." Vol. XIX. No. 5. December, 1920. 20 pp. Price 2s. net. Includes paper on "Economical Design of Engineering Structures," and discussion.

British Ignition Apparatus Association.—The annual dinner will be held at the Trocadero Restaurant, Piccadilly Circus, on Wednesday, January 12th, at 7.30 p.m.

The People's Union for Economy.—This society has now established its headquarters at 1, King's Buildings, Millbank, Westminster, S.W. 1. It will aim at keeping a watchful eye upon all Government expenditure, with a view to directing attention to overlapping and waste in the Administrative sphere. For this purpose it invites all those who agree with its views to give it their support by joining the Union, and by supplying reliable information of any instances of public waste and extravagance. Forms of membership may be obtained on application to the hon. secretary at the above address.

The Effect of the Eight-Hour Day.—An official report on the effects of the introduction of the eight-hour day in Sweden, states that only one-ninth of the workmen have maintained their full monthly production by increased intensity of labour; about one-half show a reduced production corresponding to the diminished number of working hours; the average decrease in production amounts to at least 6 per cent. According to the Foereningen's calculations, Swedish industry as a whole has lost Kr. 150,000,000 since, and owing to, the introduction of the eight-hour day.—*Reuter's Trade Service* (Stockholm).

Tramway Workers' Wages.—The Industrial Court, held on December 7th, to arbitrate upon the claim of the skilled workmen employed in the tramway, electricity, and highways department of the Sunderland Corporation, for an annual holiday of 12 days, with pay, has decided that the claim is not established. The award states:—"According to the evidence, the men concerned are not permanent employés of the Corporation, although they appear to have something like continuous employment. Their conditions of service are not settled by the Corporation, and this appears to establish a distinction between the skilled workers and other municipal employés of classes confined to service in public utility undertakings. The Court gather that it is a feature of employment in the service of the Corporation that skilled men and others similarly placed shall be paid the agreed district rate, and be subject to the general conditions of employment in force in the district. This is, no doubt, well understood by the men on engagement, and they must be assumed to accept service on those terms, although it is, of course, open to the Corporation to introduce, or to agree to, such improvements in the conditions as may be deemed advisable."

Lead Report.—MESSRS. G. CAWSON & CO. write under date January 1st, 1921:—Our last report was dated December 18th, 1920. Since that date the market has been irregular with some wide fluctuations, with business done down to £21 10s. for prompt and January, and up to £24 15s. for April. The closing is firm with a good demand for prompt and January lead. Final prices are:—

Prompt and January	£23 10	to	£23 15
February and March	£24 10	to	£24 15
April	£24 10	to	£25 0

There has been a large turnover of lead, and shorts have been covering freely. The supply of prompt lead has now become very limited. The heavy arrivals at the end of December seem to have disappeared.

MESSRS. JAMES FORSTER & CO. write:—Although there is talk of hidden stocks in Spain, the reports from that country, and also from Australia, are to the effect that none of the mines can produce at a profit at anything like present values. Values during the last fortnight have been considerably below those ruling in the early summer of 1914, and there is little risk in consumers covering their requirements for some time to come, at current prices.

Anglo-German Debts.—British Nationals, who have registered claims against German Nationals in respect of pre-war debts, will shortly receive a notification from the Clearing Office that the last day for making the necessary statutory declaration in support of their claims is March 31st, 1921. No claim in respect of pre-war debts will be admitted which is lodged after that date, unless the Controller of the Clearing Office is satisfied that the omission to lodge the declaration by the date mentioned arose from circumstances for which the creditor could not justly be held responsible.

German Export Duties.—A decree has been issued at Berlin abolishing the export duties on many engineering and metal products.

A New French Company.—A new company has lately been formed in Paris (25, Rue de Clichy), with a capital of 2,500,000 fr. and the title La Société Francaise pour l'Exploitation des Brevets Bates (Poteaux pour Suspension de Cables Electriques) to manufacture the Bates type of electric mast.

For Sale.—The Great Western Railway Co. have for disposal one 4-pole B.T.H. generator and three slate panels with various connections; Accrington Corporation Electrical Engineering Department invites offers for two 500-kW Belliss-Dick-Kerr compound-wound generating sets; Liverpool Corporation Electricity Supply Department has for sale two 2,000-kW Westinghouse-Parsons turbo-alternators, with condensers, air-pumps and Gwynne circulating pumps; Stoke Newington Borough Council Electricity Department has for disposal a battery of accumulators, with boosters and control board; Shipley Urban District Council Electricity Department has for disposal one Parsons turbine-driven d.c. dynamo direct-coupled with condenser, switchgear; Buxton Corporation Electricity Department invites offers for two Belliss & Morcom generating sets, and one engine only. For particulars, see our advertisement pages to-day.

Forthcoming Exhibitions.—The following exhibitions are being organised:—

Birmingham.—March 21st-May 21st.—National Trades and Industrial Exhibition.

Cardiff.—January 26th-February 5th.—Health and Home Exhibition. (See ELECTRICAL REVIEW, October 22nd.)

London.—February 10th to 26th.—"Efficiency" Exhibition at Olympia. (ELECTRICAL REVIEW, June 25th.)

London, Glasgow and Birmingham.—February 21st to March 4th.—British Industries Fair. (ELECTRICAL REVIEW, August 13th, September 24th, October 8th, November 12th and 26th.)

London.—March and October.—Society of Motor Manufacturers and Traders at Olympia.

London.—April 1st to 30th.—Builders' Exhibition at Olympia.

London.—June 3rd to 17th.—Rubber Trades' Exhibition at Royal Agricultural Hall. (ELECTRICAL REVIEW, April 9th.)

London.—July 4th to 15th.—London Fair and Market at Royal Agricultural Hall.

London.—September 7th to 28th.—Shipping, Engineering and Machinery Exhibition at Olympia. (ELECTRICAL REVIEW, November 12th.)

London.—November 17th to 25th.—Public Works, Roads and Transport Exhibition.

London.—1923.—British Empire Exhibition. (ELECTRICAL REVIEW, May 14th, June 11th, September 24th, and November 5th.)

South Africa.—March 9th to 16th.—Chemical, Metallurgical, and Mining Exhibition in Johannesburg.

British Dominions.—1921.—Dominions Touring Exhibition (South Africa, Australia, Canada, and New Zealand). (ELECTRICAL REVIEW, March 26th and August 6th.)

Brussels.—April 4th to 20th.—International Commercial Fair. (ELECTRICAL REVIEW, December 17th.)

Ghent.—April 16th to June 14th.—International Exhibition of Architecture, Building, and Kindred Industries. (ELECTRICAL REVIEW, September 24th.)

Iceland.—June.—World's Fair.

Lima.—June 1st to October 31st.—International Industrial Exhibition. (ELECTRICAL REVIEW, November 12th and December 31st.)

Peking.—March, 1921.—International Exhibition. (ELECTRICAL REVIEW, September 10th.)

Lyons.—March 1st to 15th.—Metallurgy, Engineering, Building, &c., Fair.

Mexico.—September.—Commercial and Industrial Fair.

Milan.—April.—International General Manufacturers' Fair.

Utrecht.—September 6th to 16th.—International Fair. (ELECTRICAL REVIEW, December 24th.)

Buenos Aires.—1922.—International Exhibition.

Rio de Janeiro.—1922.—International Centenary Exhibition.

The Metal-Filament Lamp and Fittings Industry.—At the meeting of the Illuminating Engineering Society on December 14th, the report of the Committee on Progress in Electric Lamps and Lighting Appliances was presented. It stated that the demand for vacuum-type lamps could now be met for all standard types, and in most cases adequate stocks were available to meet the increased demand due to the cessation of summer time. There was evidence of real development in the exportation of electric lamps abroad, particularly to the British Colonies. The difficulties which previously handicapped the manufacturers, such as the shortage of bulbs and tubing and also the poor quality of these, had been very largely overcome by the increased production of such material in this country. The production of gasfilled lamps had increased five or six times during the last twelve months, and the demand for most of the standard sizes could now be met. Most of the leading manufacturers were rapidly extending their production still further.

During the past twelve months the manufacturers had again been able to give attention to the production of metal-filament lamps for special purposes, such as standard candle lamps, double-ended tubular lamps for window and cornice lighting, and various patterns of reflector type lamps. Such special lamps could now be obtained in any of the standard voltages and wattages without undue delay. The principal manufacturers had introduced a range of suitable fittings for gasfilled lamps to suit all voltages for which such fittings were required, *i.e.*, street lighting, works lighting, the lighting of railway termini or other large areas, and shop-window lighting. They had also introduced a variety of small shades and bowls for use in connection with the lower wattages of gasfilled lamps, which met a very real need for shop-window lighting and the lighting of small areas. By this means the efficient gasfilled lamp was able to be used, the light distributed in the right direction, and all glare eliminated.

Christmas Tree.—In accordance with their usual custom, MESSRS. CUNNINGHAM, LTD., of 169-171, Edgware Road, W. 2, gave the children of Paddington Green Hospital an electrically-illuminated Christmas tree, and toys and crackers to each little patient.

Electricity Works Dinner.—On December 18th the staff and employés of the Maidstone Corporation electricity works held a dinner at the Corn Exchange, when the borough electrical engineer (Mr. E. E. Hoadley) presided. After dinner an enjoyable smoking concert was given by a number of excellent artistes.

New C.A.V. Developments.—It is reported that MESSRS. C. A. VANDERVELL & CO., LTD., have acquired the patent rights of the Willard Storage Battery for the British Empire (except Canada), and will shortly commence manufacture, besides establishing a chain of service stations. The company is also bringing out a new coil ignition device, designed by Mr. A. H. Midgley.

Italian Workers' Threat.—The Chamber of Labour in Turin threatens the re-occupation of the factories unless the daily hours of work are reduced to six instead of eight. Owing to the lack of materials, the reduced production of the factories renders necessary the dismissal of workmen. The Chamber of Labour wishes to avoid the necessity of dismissals by reducing the hours of work.—*Morning Post.*

Socials.—Under the auspices of the Sports and Recreation Association of the PHŒNIX DYNAMO MANUFACTURING CO., Bradford (a branch of the ENGLISH ELECTRIC CO.), a series of Christmas parties have been held for the children of employés. Very enjoyable programmes were arranged, including a fairy play, written by Miss E. Matthias, the welfare superintendent.

The girls of the staff of the EDISON SWAN ELECTRIC CO., LTD., gave a New Year's Eve supper, concert and dance on December 31st, in the Staff Café, at Ponders End. A merry company of about 80 sat down to an excellent repast, under the genial chairmanship of Mr. J. W. Elliott (joint sales manager). A concert followed, at which Miss Robinson, Mr. Moore and Mr. S. Barker supplied the vocal items, while Messrs. Will May, E. Lack, G. W. Tuffill and "Little Jack" supplied the humorous numbers. At the conclusion of the concert, a programme of 10 dances was gone through to the music of the Ediswan orchestra.

The German Glow-Lamp Combination.—A big capital transaction is contemplated by the Osram group, which will raise the total nominal capital to 240,000,000 marks. The Osram Co., which is composed of the glow lamp works of the A.E.G., the Siemens & Halske Co., and the Auer (German Incandescent Gas Light Co.) Co., reports that after defraying all expenses and taxes, the financial year ended on June 30th, 1920, shows divisible net profits of 27,000,000 marks, the method of disposal of which has not yet been disclosed. As a result of the large turnover, and the acquisition of most of the undertaking of the United Lausitz Glass Works, makers of tubes for bulbs, it is found necessary to strengthen the financial position, and for this purpose it is proposed to increase the share capital from 30,000,000 to 120,000,000 marks. The existing loan of 50,000,000 marks is also to be supplemented by a new 5 per cent. mortgage loan for 70,000,000 marks.

The E.P.E.A. Award.—We are informed that about twenty-five undertakings still refuse to adopt the recommendation of the National Joint Industrial Board regarding the salaries to be paid to members of the staffs of electricity undertakings. Negotiations between these undertakings and the Ministry of Labour are still proceeding. The Ilford Council agreed to adopt the schedule for six months, but this was unacceptable to the E.P.E.A. Strike notices in this case were suspended, however, and the question is to be brought up at the next ordinary meeting of the Ilford Council.

Trade Union Fusion.—On December 31st the National Warehouse and General Workers' Union and the Amalgamated Union of Co-operative and Commercial Employés ceased their separate existences and became merged into the National Union of Distributive and Allied Workers. The new Union covers a wide variety of workers, from the producers of household necessities through the wholesale factors to the retail shop workers, and is very powerful from a Trade Union standpoint. A large mansion has been purchased at Fallowfield, Manchester, to be the central offices of the new organisation. The membership of the amalgamation reaches nearly 200,000, with accumulated funds of £300,000, the membership of the approved society being 32,000.—*Daily Telegraph.*

British Property in Germany.—It is officially announced that an agreement was signed on December 31st, by the Secretary of State for Foreign Affairs and the German Ambassador, for safeguarding the restitution of British property in Germany under Article 297 of the Treaty of Peace, and meeting certain difficulties with regard to storage and other charges incurred on such property where it was not actually taken over by the German authorities. Certain clauses of the agreement can only be carried into effect by the passage of legislation in Germany, but in the meantime it is to be applied without delay, so far as can be done by administrative action; no actual release of German property will be made, however, until the necessary steps have been taken in Germany, and the agreement has been ratified.—*The Times.*

Rio Tinto Strike Settled.—The employés' strike at the Rio Tinto Copper Mines, Spain, has been settled following the intervention of the Minister of War. The miners accepted the English company's conditions, but reserved the right to discuss certain points at a later date.

Copper and Lead Prices.—MESSRS. F. SMITH & CO. report, January 4th:—Copper (electrolytic) bars, £83 10s., 10s. decrease; ditto sheets, no change; ditto wire rods, £99 10s., 10s. decrease; ditto H C wire, 1s. ½d., ⅛d. decrease.

MESSRS. JAMES & SHAKESPEARE report, January 5th:—Copper bars (best selected), sheets, and rods, £130, £2 decrease. English pig lead, £25 5s., an increase of 15s. on last week's quotation.

District Joint Board.—At a meeting of the Home Counties (No. 9 Area) District Joint Board, held on December 22nd, 1920, it was reported that the following members had been nominated by the E.P.E.A. to sit on the employés' side :—Messrs. H. M. Bowman and A. T. Bullen (Bedford); F. Chignell (Colchester): H. A. Kell (Luton); and E. E. Pope and H. Wilson (Maidstone). Mr. Wilson was elected vice-chairman, and Mr. Bullen will act as secretary for the staff members' side.

Demand for Plant in S.A.—*The South African Engineer and Electrical Review*, in the course of a trade article, states that, as regards electrical plant and supplies, reports received from public bodies all tend to indicate that there is still a shortage, and that plant on order for very long periods has not yet been delivered. Most of the leading municipalities are not only unable to give extended supplies of electricity, but are still, with difficulty, coping with the existing demand with no reserve for emergencies. With regard to electrical goods, the market has been glutted with certain lines, such as lamps, which were over-imported in 1918 by speculators, but in most lines, such as heating and cooking apparatus, telephones, conduits, &c., supplies have been at times unprocurable at any price. One municipality reports finding it cheaper to use high-pressure steam pipe than ordinary electrical steel conduit. Apart from the difficulty of getting delivery of machinery against old contracts, it has been found almost impossible during the year to place orders in the United Kingdom. In spite of the adverse rate of exchange, America has taken practically every important order for large plant owing to the apparent inability of British manufacturers to quote firm either for delivery or price. At the present time public bodies are faced with the choice between paying what seem prohibitive prices and turning down all schemes for extended activities.

Trade Discounts in Canada.—The following extract from the *Electrical News* (Toronto) shows that a question which is agitating retailers in this country is equally acute in the Dominion :—"Sell electrical appliances as they do postage stamps." The manager of a large central station company has just written us regarding the retailing of electrical appliances through hardware and drug stores. It is typical of many such expressions of opinion which one hears on all sides. This manager writes :—"It is a crying shame the way wholesalers, distributors, &c., sell electrical goods to hardware shops, plumbing shops, tinsmiths and others not in the electrical business—even to consumers—at the same discounts given to *bonâ fide* electrical shops. These people then sell those goods as a side line at practically nothing above cost, as a drug store sells postage stamps, simply to attract the public. This results in the public getting the impression that the electrical shops are charging exorbitant prices. Furthermore, the hardware men and others frequently have below-standard goods foisted on them, whose poor quality eventually does an injury to the electrical business as a whole. What is needed is co-operation between representatives of all electrical men, from the manufacturers down to the retailers."

LIGHTING AND POWER NOTES.

Aberdeen.—PROPOSED EXTENSIONS.—At a meeting of the Electricity Committee on December 22nd, a scheme for the extension of the electricity works was examined. The proposals comprised the installation of a 10,000-kW turbo-alternator at a cost of £77,000; two boilers with economisers, forced and induced-draught apparatus, &c., £60,000; two motor converters of 1,000 and 1,500-kW capacity, £18,000; high and low-pressure switchgear, &c., £10,000; a 60-ton electrical crane, £6,400; and necessary alterations and extensions of buildings at an estimated cost of £20,000, making, with allowance for contingencies, a total of £210,540. The Committee was inclined to approve the suggestions, but decided to make further investigation before finally sanctioning them.

Accrington.—EXTENSIONS.—The following items are included in the scheme of extensions laid before the Electricity Committee, involving the expenditure of £150,000 :—Engine house : 5,000-kW turbo-generator, condenser and auxiliaries, foundations and flooring, steam exhaust and water piping, switchgear and cables, two 1,000-kW rotary converters and switchgear. Boiler-house : Four 25,000-lb. water-tube boilers, superheaters, economisers, stokers, and coal-handling plant, boiler-house alterations, foundations and ash tunnel, steam feed and blow-off piping, valves, &c., two feed pumps and connections. The report has been adopted. The Electricity Commissioners are being asked to sanction the loan.

Australia.—SYDNEY PLANT OVERLOADED.—The outspoken statement made by the city electrical engineer that the Council was responsible for the over-loading of the power-house because of its persistent refusals to get him the plant he asked for, was borne out by a report from the Electric Lighting Committee, presented to the City Council. The report stated that an accident occurred on October 12th to one of the turbo-alternators at the power-house, which resulted in the stripping of the high-pressure blading of the turbine. The temporary loss of this machine placed the department in a serious predicament. The defective blading had been cut out, and work was being carried on day and night to get the machine into service again. It was hoped to replace the blading from spare blading in stock. The machine was one of the older sets, and was getting into very bad condition. "The condition of this set," the report concluded, "and the accident which has occurred emphasises the urgency of installing new plant to relieve this plant as quickly as possible."—*Daily Telegraph* (Sydney).

COAL SHORTAGE.—The city electrical engineer has informed the Council that it is impossible to generate electricity economically until a coal mine is purchased. The Council is, therefore, inviting offers of coal-bearing properties capable of supplying at least 6,000,000 tons, and also of controlling interests in other mines.

The fall in metal prices and the extension of the shipping strike are affecting all the dove-tailed industries and seriously reducing employment. Victoria and other States are unable to obtain supplies of coal from Newcastle, and are on the verge of a coal famine. The Federal Government has prohibited the use of gas and electric light and power except within severely restricted hours, while the Railway Administration is preparing a 35 to 50 per cent. reduction of the train services. Melbourne is threatened with the suspension of all tramway traffic after sunset and on Sundays.—*The Times.*

Barnes.—LOAN.—The Urban District Council is applying for sanction to a loan of £10,000—the estimated cost of mains and services for the ensuing three years.

Birkenhead.—WATER POWER.—A scheme to utilise water from the town's reservoir in North Wales to generate electricity is being considered by the Town Council, says *The Times*. Ten million gallons of water are released daily at the reservoir, and it is proposed to use the water power to generate electricity, which will be conveyed a distance of 40 miles to Birkenhead and Wirral by means of an overhead transmission line.

Bentley (York).—HOUSING SCHEME.—At a meeting of the Bentley-with-Arksey District Council recently, minutes approved included the prospective lighting by electricity of houses at Arksey. Inquiries had been made of the Doncaster Corporation, and quotations were considered. It was decided to ask the Corporation to undertake the wiring from the sub-station to the houses, and that if it declined, the Housing Commissioner should be asked to allow the cost of wiring to go for subsidy as part of the housing scheme. In default of any concession from the Corporation, Messrs. Barber, Walker & Co. were to be asked to estimate for supply of electricity. It has since transpired that Doncaster Corporation is reconsidering the matter.

Bingley.—LOAN.—The District Council is applying for power to borrow £1,500 for the provision of further new electricity mains and services.

Birmingham.—NECESSITY FOR EXTENSIONS.—Owing to financial stringency, the Finance Committee, in a special report to the City Council, stated that it could not at present authorise further expenditure on housing schemes or upon the recently-sanctioned extension scheme of the Electric Supply Committee. The Electric Supply Committee urged the imperative necessity of putting the extension scheme in hand. It pointed out that the erection of the first portion of the Nechalls works, with a net plant capacity of 30,000 kW, was authorised by the Council on July 31st, 1918. Although efforts had been made to press forward with the works, the plant would not be ready for service until the autumn or winter of 1921. The department had had to impose certain restrictions on consumers, and it had upon its books 3,500 applications for supply, including large and small works, business premises and private houses, but it could not, with its present limited plant capacity, deal with new business. Various measures had been taken by the Committee to alleviate the difficulty by temporarily supplementing the sources of supply, but it had proved impossible to provide adequate facilities to meet the requirements of present and prospective consumers. The report further pointed out that the existing plant was working to its full capacity, and that when any breakdown occurred the remaining plant had to be overloaded, or the supply curtailed. This state of things could not continue indefinitely, and the Committee recommended that it be authorised to proceed with the scheme at once.

U.S.A. LOAN.—The possibility of the Corporation having to consider the raising of a loan in the United States of America is foreshadowed in the report of the Finance Committee which was presented to the City Council on Tuesday last. "If further contracts are to be entered into, such as those for the new electric power station and the housing scheme, the treasurer advises that such a step may be necessary," says the report.

Brazil.—WATER POWER.—A concession was granted in 1907 to an American firm for a hydro-electric plant on the Paraguassu River, says the United States Consul at Bahia in his latest report. The concession was later transferred to the Companhia Brazileira de Energia Electrica, a subsidiary of the American firm. A natural fall on the Paraguassu River has been used to generate 5,000 h.p., and it was hoped at the time of writing that the plant would be inaugurated during the latter part of 1920. The company will supply the city of Bahia with light, as well as power for the tramway system. It also expects to supply power to a number of the local manufacturing firms and sugar refineries, thus reducing the demand for coal and fuel.

A hydro-electric plant was recently inaugurated by the Companhia Valenca Industrial. It is built on the falls of the Una River, and besides supplying power for the textile factory of the above-mentioned company, it will supply the city of Valenca with electric light.

Canada.—Export of Energy.—The Hydro-Electric Power Commission of Ontario desired to prohibit the export of electric energy to the United States, but this did not receive the Government's approval. As an alternative, a reduction has been effected in the export licences from 110,000 kW. to 80,000 kW.

Continental.—Spain.—A new company has lately been formed in Barcelona, with a capital of 15,000,000 pesetas, and the title La Sociedad Termo-Energia, to exploit certain lignite mines and to generate and distribute electrical energy.

Dorchester.—Purchase of Undertaking.—The Corporation is applying to the Electricity Commissioners for a special order to authorise the Dorset Electric Supply Co., Ltd., to sell to the Corporation the electric supply undertaking and to authorise the Corporation to generate and supply electricity.

Downton (Wilts).—Inquiry.—An inquiry was held recently by the County Council into an application of the Parish Council for a loan of £650 for public lighting by electricity. The supply was offered by the Southern Tanning Co., Ltd., subject to the provision of mains by the Council. It was stated that the supply would not be available for private use. Objection was made on the ground of increased rates, and also because the entire parish would not be lighted.

Dundalk.—Report upon Extensions.—Mr. P. A. Spalding, engineer and manager of the electricity works, has presented to the Urban Council a report on proposed works extensions, which, he states, are urgently required. New plant is estimated to cost from £15,000 to £20,000.

Dundee.—Position of Undertaking.—Mr. Richardson, the Corporation electrical engineer, reports that he hopes to have new plant installed by the end of April at Carolina Port which will meet next winter's demand. For the winter of 1922-23 further steam plant, estimated to cost half a million pounds, would be needed to meet the requirements of consumers. The machinery would have to be ordered at once. The Corporation Electricity Committee discussed the possibility of a hydro-electric scheme being developed to meet the city's requirements, and the engineer stated that under the most favourable circumstances such a scheme could not be ready before the lapse of four or five years. The Committee instructed Mr. Richardson to submit a report on steam plant, and also agreed that Prof. A. H. Gibson and Mr. Richardson be invited to report as to the best methods for future extension of the city's generating resources and also on the hydro-electric proposals.

Electricity Districts.—West Riding (Aire and Calder).—The Electricity Commissioners have extended the time for the submission of objections or representations to February 28th, 1921.

North-East Midlands.—The time for the submission of objections or representations has been extended to March 31st, 1921.

Enniskillen.—Electric Lighting Investigation.—In view of the proposed increases in the charges for gas, the Urban District Council has retained the services of an expert to advise it as to the feasibility of establishing a municipal electric lighting scheme.

Falkirk.—House Lighting.—On the recommendation of the Corporation electrical engineer, the houses being erected by the Town Council are to be supplied with electricity, a loop-system of cabling being adopted.

Heston and Isleworth.—Increased Lighting.—The Lighting Committee reports that in view of the very small saving it finds to be effected by the non-lighting of one-third of the electric street lamps in the district, it has given instructions for the whole of these lamps to be lighted.

Leeds.—Loan.—Application is being made to the Electricity Commissioners for sanction to borrow £40,000 for house services.

Leyton.—Insurance.—At a meeting of the Lighting Committee, the electrical engineer reported that when the turbine was installed, the Committee considered it preferable to set aside £50 a year as a Self-Insurance Fund instead of insuring with an insurance company, and suggested the same course should be adopted with regard to the two motor converters to the extent of £25 per annum each; the Committee recommended that this suggestion be adopted.

Glasgow.—Loan.—The Corporation is applying to the Electricity Commissioners for authority to borrow an additional £1,800,000 for the Electricity Department.

New Turbo-Generator.—The Clyde Valley Electrical Power Co. is erecting at its Clydemill power station a 15,000-kW turbo-generator. A 33,000-V inter-connecting cable between the Clydemill and the Yoker generating stations is being laid.

Halifax.—Extensions Recommended.—The Electricity Committee recommends the expenditure of nearly £40,000. Of this £28,000 is for two new boilers at the generating station.

Kingussie.—Electricity Scheme.—Mr. Mitchell, Edinburgh, has reported to the Town Council in connection with the proposed electricity scheme for the town. There are three schemes put forward:—Power from the Guynack Burn and Loch Guynack; power from the River Tromie; and the installation of oil or gas engines. The cost of the schemes is estimated by Mr. Mitchell at £8,820, £11,521, and £6,570 respectively.

Leyton.—Parliamentary Bill.—The Urban District Council proposes to promote a Bill during the ensuing session of Parliament, one of the sections of which seeks to extend the Council's powers with respect to the electricity undertaking.

Machynlleth.—Public Lighting.—It is reported that the Kinema Co. has intimated that it is prepared to provide electricity for lighting the whole of the town.

Malta.—Inadequacy of Plant.—It is stated that the Government electricity plant is unable to meet the demands made upon it, and orders for new plant are being placed immediately in an endeavour to be able to cope with the next winter's load.

Newmill (Yorks.).—Joint Electric Lighting Scheme.—A meeting of representatives of the Newmill, Farnley, Shepley, and Thurstonland Councils has been held to consider the question of a joint electric lighting scheme. The local representatives reported that it had been decided to obtain electric power in bulk from the Yorkshire Electric Power Co.

Oldham.—Overloaded Plant.—When complaints were made regarding the electricity supply, Mr. F. L. Ogden, electrical engineer, told the Committee that the cause was the overloading of the direct-current plant, and he advised that there should be no more connections made this winter. The department had no spare plant, and they were running at a risk.

New Zealand.—Hydro-Electric Requirements.—An elaborate statement regarding the development of hydro-electricity was given by the Minister for Public Works in an address to the New Zealand House of Representatives. The appropriations for the current financial year are set out in the Estimates as follows:—Arapuni scheme, £100 000; Mangahao scheme, £250,000; Horahora scheme extension: New works, £80,000; material for stock, £10,000; working expenses, £10,000; Lake Coleridge scheme: New works, £150,000; material for stock, £10,000; working expenses, £22,500; Survey and investigation of other schemes: North Island, £15,000; South Island, £15,000; total, £662,500; less estimated credits on capital account, £7,500, leaving a net total of £655,000. The expenditure during 1919-20 on the various schemes amounted to £58,970.—*Reuter's Trade Service* (Wellington).

Perth.—Interview with Commissioners.—The city's £25,000 scheme for the introduction of additional plant at the Corporation's electricity works is still in abeyance, pending the decision of the Electricity Commission. Reporting on an interview he had had with a member of the Commission, Mr. John Lambert, the electrical engineer, stated that amongst the questions discussed was that of introducing three-phase into the city, in which connection it had been pointed out to him that Perth being particularly a residential town, scope for producing a large industrial load was very limited. The electricity works, it had been further contended, having been designed as they unfortunately were, such an extension would be a most expensive venture, and one that could not give an adequate return for the outlay it would entail. The installation of coal elevators was also discussed. The Corporation Electricity Committee has deferred consideration pending the receipt of the Commission's finding.

South Africa.—Port Elizabeth.—The City Council is to borrow £550,000 for public works, one of the items being £200,000 for extension of the electricity undertaking, mains, &c. (including amount already spent).

Southend.—House Services.—It was stated by the electrical engineer, at a recent Council meeting, that the cost of connecting consumers to the mains had risen from £3 10s. in 1914 to £8 4s. The Council has decided not to pay the cost of these services out of revenue, as hitherto, but is seeking permission to borrow £24,000 to cover the cost for a period of years.

Cause of Failure.—The chairman of the Electricity Committee informed the Council, at a meeting, that the cause of a recent failure of power, resulting in a stoppage of the tramway services, was the extremely bad coal delivered to the works. He stated that this had actually extinguished two of the boiler fires. A deputation was appointed to meet the Chief Coal Controller.

Engineer's Vindication.—Owing to the criticism of the Electricity Committee regarding the present inadequacy of the electricity undertaking, the borough electrical engineer (Mr. Robert Birkett) has been forced to vindicate his position in the matter through the columns of the local Press. He states that he has done everything in his power and promises that the position will soon be improved.

Stalybridge.—Joint Scheme Abandoned.—The Stalybridge, Hyde, Mossley, and Dukinfield Joint Tramways and Electricity Board has been endeavouring to arrange with the Ashton-under-Lyne Corporation to form a joint electricity undertaking, but the Corporation has made other arrangements, and the Board will have to work on its own. The Board has authorised the engineer to get another water-tube boiler, as the increased load makes the provision of further steam-power imperative. The calls now being made are quite abnormal and unexpected, but the new boiler will be the limit of capacity at the Tame Valley station, and the capital outlay upon the proposed new generating station at Hartshead is greater than can be undertaken at present.

Stafford.—REPORT ON UNDERTAKING.—The Corporation has approved a recommendation of the Electricity Committee to retain the services of Mr. Arthur Ellis, of Cardiff, to prepare a comprehensive report upon the electricity undertaking at a fee of 200 guineas.

Stockport.—BREAKDOWN.—An accident at the electricity works on December 30th, caused by a "short" on a 5,000-kW turbo-generator, resulted in a stoppage of the tramway services and works using electricity. No electricity was supplied to any works until Monday. Thousands of workpeople were affected by the stoppage.

Stoke-on-Trent.—PRICE REDUCTION.—The *Staffordshire Sentinel* states that the Electricity Supply Committee has recommended that from the meter readings at the end of the September quarter, 1920, and until further notice, the charges for motive power supply, heating, cooking, and apparatus used in conjunction therewith, be reduced by 25 per cent., making 150 per cent. in all over tariff rates, except in cases where the supply is three-phase alternating, transformed on the consumer's premises; and that the charges for private lighting, upon which the present advance is 125 per cent., be reduced by 35 per cent., making in all 90 per cent. upon tariff rates. These reductions have been made possible by the profit made during the past year, and it is stated that the accounts will still show a substantial profit when the reductions are put into force.

Stourbridge.—ELECTRICITY DISTRICTS.—The Town Council has decided to lodge objections to the proposed inclusion of the borough in either the North-West or South-West Midlands Electricity Districts.

United States.—FORD HYDRO-ELECTRIC SCHEME.—Messrs. Henry Ford & Son, Inc., have applied for a licence to authorise the construction, operation and maintenance of a hydro-electric power plant on the site of the Government dam at Green Island for the purpose of utilising the surplus water at that point for a motor manufacturing plant.—*Reuter's Trade Service* (Troy, N.Y.).

Wigton.—WORKHOUSE PLANT.—The Board of Guardians has decided to lay down a steam plant capable of providing electricity for lighting the workhouse, and also for heating the institution at an estimated cost of £1,600.

Wrexham.—HOUSE LIGHTING.—The Town Council is applying for permission to borrow £14,700 for the provision of an electricity supply to the 800 houses being built by the Council.

TRAMWAY AND RAILWAY NOTES.

Continental.—FRANCE.—A concession granted to M. Coignet some time ago for the setting up of a tramway network in the Departement de l'Yonne, has now been transferred to the Omnium Française d'Electricité Co., which, with its ample means, will soon carry the scheme to a conclusion. This company has also received the authorisation to submit plans for the utilisation of the water resources of this region, estimated to be equal to about 20,000 h.p., and for the distribution of electric energy.

SPAIN.—The Norte Compania has submitted a scheme for the electrification of the Barcelona to Tarragona line. The works were to be commenced at the beginning of the present year and ended, if no interruption occurred, in 1923. Other schemes are being examined, among which is the electrification of the Barcelona to Saragossa Railway. Another large undertaking, work on which was retarded during the war, owing to inability to secure material, is about to be taken in hand. This is the electrification of the highland section of the Pagarès. The first portion to be converted is 42 km. in extent, and the highest part of the track is 1,270 metres above sea-level. This line is very often covered with snow, and difficult to operate with steam traction.

Guernsey.—ELECTRIC VEHICLES.—We understand that Mr. A. G. Bird, A.M.I.E.E., engineer and manager of the Guernsey Railway Co., Ltd., is considering the feasibility of adopting electric road vehicles suitable for carrying loads of from 4 to 5 tons each.

Halifax.—THROUGH-RUNNING OF CARS.—The Tramways Committee have authorised the engineer to enter into arrangements with Bradford Corporation for the running of the Bradford railless electric battery cars through from the Bradford tramway system to Halifax, in connection with the carriage of parcels between the two towns.

The engineer and a deputation are to negotiate with the Brighouse authorities with regard to the establishment of a system of electric signals on the Halifax tramway route in Brighouse area.

Holland (Lincs.).—LIGHT RAILWAY SCHEME.—Having received the unofficial approval of the Ministries of Transport and Agriculture and Fisheries, the plans for the proposed light railways have been completed. The estimated cost of the entire scheme is given as £548,000, which is to be apportioned as follows among the authorities concerned:—Holland County Council, £423,000; Lindsey County Council, £45,000; Cambridgeshire, £48,000; and the Soke of Peterborough, £32,000.

London.—TUBE BREAKDOWN.—Some delay was caused on the City and South London Railway line on Tuesday morning last by the breakdown of a train at Kennington.

Newcastle-under-Lyme.—PROPOSED CURTAILMENT OF SCHEME.—A notification having been received from the Parliamentary agents of the North Staffs. Railway Co. stating that it was intended to apply for powers to abandon the construction in part of the light railways authorised by the North Staffs. Railway (Trentham, Newcastle, and Silverdale Light Railways) Order, 1914, the Rural District Council has decided, in view of the advantages which the railway would confer in the conveyance of passengers and goods, to disapprove of the abandonment of the schemes.

South Shields.—LIGHT RAILWAY ORDER.—Under the South Shields Corporation Light Railway Order, 1920, authority is given for the construction of a light railway within the areas of the county borough and the rural district of South Shields.

Salford.—YEAR'S WORKING.—The gross income of the Corporation tramways for the year ended March 31st, 1920, was £495,025, as compared with £425,384 in the previous period. The gross profit amounted to £119,528, as against £130,883. After payment of capital charges, a net profit of £37,610 (£42,672) remained, of which amount £20,000 was allocated to rate relief. The depreciation and renewals fund shows a balance of £22,171.

Southport.—TRAMWAY FEEDERS.—The insulation of the feeders of the Corporation tramways has perished, and the borough electrical engineer reports that it is necessary either to re-insulate them and re-lay them at an estimated cost of £14,950, or to place overhead feeders on the tramway poles at a cost of £5,200, less an estimated credit of £2,600 for the sale of the old material, the existing tramway poles being utilised after being strengthened by means of reinforced concrete. The Electricity Committee has instructed the engineer to proceed with the latter arrangement.

Warrington.—PROPOSED FARE INCREASE.—To put the tramway undertaking on a sound economic basis, the Tramways Committee has recommended a 2d. fare on all routes, with 1d. stages.

Wrexham.—LIGHT RAILWAY.—At a recent meeting of the Town Council a letter was read from the Clerk of the County Council stating that an interview had been held between the Light Railway Committee and the Railway Commissioner for Wales with reference to proposed light railway schemes from Wrexham to Ruthin, Denbigh to Llanrwst, Abergele to Llangefni, and Corwen to Bettwsycoed. The Commissioner desired certain information respecting the schemes, such as the approximate cost, whether the owners of the land would be prepared to give sufficient for the light railway, and whether they would support the schemes financially. It was decided to call a conference of local authorities concerned in the Wrexham-to-Ruthin scheme.—*Manchester Guardian.*

TELEGRAPH AND TELEPHONE NOTES.

Austria.—FINANCIAL POSITION.—A *Reuter's Trade Service* telegram from Vienna states that Austria's State finances are in the most precarious condition, and the Government is experiencing the utmost difficulty in finding the money to meet current expenditure. The telephone and telegraph employés and other State officials are clamouring for increased pay. Both telegraph and telephone charges were to be raised some 250 per cent. on January 1st.

Canada.—STATE TELEGRAPHS.—With New Year's Day the Canadian Government will complete the biggest telegraph merger in the history of the Dominion, which will include the extinction of several companies organised largely with English capital. The new merger will make one of the largest single telegraph systems in existence, comprising the Great North-Western, Grand Trunk, Grand Trunk Pacific, Canadian Northern, Inter-Colonial Railway, and Commercial systems, with a number of smaller companies, and the name in future will be the Canadian National Telegraphs. The new system will be conducted on similar lines to the national railway system, under an organisation as free from political influence as is possible to any Government-owned concern, while with the merger a number of changes of methods are announced which will tend to promote economy and co-ordination of services.—*Daily Telegraph.*

Continental Telegraphists' Strike.—The "keep-to-the-rules" strike of French telegraphists, which we referred to in our last issue, is, says the *Daily Express*, spreading rapidly on the Continent. Italian, Spanish, and Belgian officials are falling into line with their French colleagues. The chaotic condition of the Paris telegraph offices has become worse. There has been only one hour of telegraphic communication with Italy. All other telegrams, charged for at the usual rates, have been sent by post. Hundreds of telegrams from Italy for England arrived in Paris by post. Twelve hundred and fifty telegrams were posted there for London on December 23rd, and the post baskets for Berlin, Hamburg, and Mayence were full of official telegrams. It now takes 24 hours for a telegram to be delivered in the French provinces.

France.—GUIDING AEROPLANES BY WIRELESS. — A French engineer, M. Henri Detable, claims to be the inventor of an aeroplane which can be flown without a pilot, being guided by wireless telegraphy, says the *Evening News*. A claim for the invention has already been made by an American. Detable says he completed his machine during the war, and several trials were made. The aeroplane was guided in the air with nothing in it but a bag of ballast, and it was able to rise from the ground and land again with perfect safety. He adds that he was unable to exploit the idea through lack of capital.

A number of French Deputies have tabled a Bill to institute a separate budget for the postal, telegraph and telephone services, which would thereby cease to be a Government department, and could be administered separately on business lines.

Germany.—BERLIN-BRUSSELS TELEPHONE COMMUNICATION.—The Ministry of Posts states that the restrictions on telephone communication between Germany and Belgium were removed on January 1st, from which date pre-war conditions of communication were re-established. The fee for a three-minutes' conversation between Berlin and Brussels is six marks ninety pfennigs, and for urgent calls three times this amount.—*Reuter's Trade Service* (Berlin).

Greece.—TELEGRAPH RATES.—The telegraph authorities announce that from the 1st inst. the rates for telegrams to Greece and Greek islands were increased by ½d. on those shown in the Post Office Guide.

Poland. — SWEDISH TELEPHONE CO. — The Telefon Aktiebolaget Cedergren, whose concession to handle the telephone system of Warsaw expired on November 1st, 1919, has obtained a renewal covering a period of 20 years, together with important new concessions for several other Polish towns, including Lodz and Lemberg. It is stated that a Polish company will be formed to deal with these concessions, all the shares of which will be held by the Government and Telefon Aktiebolaget Cedergren. The share capital of Telefon Aktiebolaget Cedergren is Kr. 4,500,000, and is entirely in the hands of the Swedish-Danish-Russian Telephone Co., whose share capital amounts to nearly Kr. 22,000,000.—*Reuter's Trade Service* (Stockholm).

Spain.—FIRE.—It is reported that a serious fire at Segovia, 43 miles N.-W. by N. of Madrid, did extensive damage, and ruined 15 large buildings, including postal, telegraph, and telephone offices.

Wireless Telephony.—A proposal is under the consideration of the Mersey Docks and Harbour Board to establish communication between the Bar lightship and the Dock Board's offices by means of wireless telephony.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—SYDNEY.—January 31st. Municipal Council. H.T. and L.T. cable (specification No. 628). Electric Lighting Department, Town Hall, Sydney.

SOUTH AUSTRALIA.—P.M.G.'s Department. March 2nd. Telephone parts, Schedules 558 and 559; telegraph and telephone material, Schedule 560. (See this issue.)

Belgium.—Commune of Ixelles at Brussels. 5,000-kW, 5,000-V, 3-phase alternator, exciter and condenser. A copy of the specification (in French) may be seen on application to the Department of Overseas Trade (Room 48), 35, Old Queen Street, S.W.1.

January 19th. The Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels. Supply of telephone commutators and other telephonic apparatus. The specification (No. 545) may be obtained for 1.75 francs from above address.

ANTWERP.—February 1st, Municipal authorities. Transformer set with switchboard for a transformer cabin at the docks. Copies of the specification may be obtained for 3 francs from the Hotel de Ville, Antwerp.

Edinburgh.—January 24th. Electricity Supply Department. Circulating water pipes and valves for the Portobello generating station, Specification No. 30. (See this issue.)

Halifax. — February 3rd. Electricity Department. Twelve months' supply of stores, including electric lighting fittings and accessories, cables, V.I.R., and phosphor bronze, telephone wire, e.h.p. and l.p. cables, meters, &c. (See this issue.)

India.—MEERUT. — January 17th, 1921. Government of United Provinces hydro-electrical installation. Generating station equipment, including workshop equipment, H.T. transmission and distribution (overhead equipment, including poles), sub-station equipment, pumping station equipment and piping, &c. Mr. G. McHoey, sanitary engineer to the Government, United Provinces, Allahabad.—*Reuter's Trade Service* (Bombay).

London.—HAMMERSMITH. — January 21st. Electricity Department. Three or more water-tube boilers capable of supplying 150,000 lb. of steam per hour. (See this issue.)

Manchester.—January 24th. Electricity Committee. Six motor-driven circulating-water pumps; three motor-driven boiler feed pumps and one motor-driven pump for weight-tank sump. (December 24th.)

January 11th. Tramway Committee. Electric welding equipment for the welding of tramway rail joints. J. McElroy, Manager, 55, Piccadilly.

Natal.—DURBAN.—January 26th. Corporation. Supply of telephone cable, paper sleeves, concrete pipes, and various telephone and miscellaneous accessories and materials.

February 16th. One 1,000-kW rotary converter with transformers and switchgear. Specifications of the above may be consulted on application to the Department of Overseas Trade, 35, Old Queen Street, E.C.

New Zealand. — NAPIER. — January 17th. Borough Council. One 500-kW electric generating set. Copies of the specifications and blue prints may be seen at the Department of Overseas Trade, 35, Old Queen Street, S.W.

Rhodesia. — SALISBURY. — January 13th. Municipal Council. Electric generating plant, switchgear, cable and converters. Specification (£3 3s.) from the Council's Consulting Engineer, Royal Chambers, Johannesburg. A copy of the specification may be consulted at the Department of Overseas Trade (Room 48), 35, Old Queen Street, S.W.1.

South Africa.—JOHANNESBURG.—January 31st, 1921. Rand Water Board. Supply and erection of steam boiler, superheater, stoker, economisers, &c., steam turbo-driven centrifugal pumps, condenser, &c., for the Swart Kopjes pumping station. Copies of the specifications, &c., and forms of tender can be seen on application to the Machinery Section, Department of Overseas Trade, 35, Old Queen Street, S.W.

CLOSED.

Blackpool.—Electricity Committee. Park Royal Engineering Co., for switches in connection with the h.p. switchgear for transformer chambers, and the Metropolitan-Vickers for h.p. switch.

Halifax.—The Tramways and Electricity Committee. Recommended:—

Babcock & Wilcox, Ltd.—Two cross-type marine boilers superheaters stokers, chimneys, and fans, at electricity works; £28,340.

E. Green & Son, Ltd.—Two economisers, each consisting of 240 tubes, for above boilers; £4,498.

Invergordon (Ross-shire).—Electric light installation, the Academy; E. Spell, £194.

London.—STEPNEY.—Electricity Committee. Accepted:—

Coal supplies—

3,000 tons Ibstock 'D/S nuts, at 24s. 1d. per ton; 3,000 tons Hawkins Cannock nutty slack, at 23s. 9d. ton; 2,000 tons West Cannock nutty slack, at 44s. 3d. ton; 5,200 tons Walsall Wood washed beans, 45s. ton.—E. Foster & Co. One barge ¾ in. Peasley slack, 24s. 1d. per ton.—Bradbury, Son & Co., Ltd. 190 tons Cowdenbeath rough slack, at 53s. 7d. per ton; 240 tons rough small, 45s. 6d.—E. Foster & Co.

Cable—

¼ mile ·007 sq. in. lead-covered cable, £74 10s.; ¼ mile each twin and 3-core armoured cable and ¼ mile ·04 sq. in. 3-core armoured cable, £329.—W. T. Henley's Telegraph Works Co., Ltd.

Morecambe.—Electricity Committee. Tudor Accumulator Co.—Repairing battery at the East Street battery station, £291.

Manchester.—Electricity Committee.

High and low-pressure valves.—Dewrance & Co., Ltd., J. Blakeborough and Sons, Ltd.

High and low-pressure piping.—Aiton & Co., Ltd.

Overhead distribution work on the Gorton Mount and Mount Road Housing Estates.—British Insulated and Helsby Cables, Ltd.

Cable.—G. N. Haden & Sons, and Pirelli-General Cable Co., Ltd.

Electric tipping truck.—Electromobile (Leeds), Ltd.

Transformers at Barton Power Station.—Metropolitan-Vickers Electrical Co., Ltd.

Sub-contractors: Oil-coolers and oil pumps, Power Gas Corporation, Ltd., and Pulsometer Co.

Two transforming plants at Stuart Street and High Street sub-stations.—Metropolitan-Vickers Electrical Co., Ltd.

Sub-contractors: Fans, Davidson & Co., Ltd.

Transformers at Oldham Road "B" sub-station.—Ferranti, Ltd.

Sub-contractors: Fans, Davidson & Co., Ltd.; motors and switchgear, British Thomson-Houston Co., Ltd.

Water screening plant at Barton Power Station.—F. W. Bracket & Co., Ltd.

Sub-contractors: Driving chains, Brampton & Co., Ltd.; reducing gear, Northern Manufacturing Co.; motors and switchgear, Metropolitan-Vickers Electrical Co., Ltd.; lifting tackle, Young & Co.

Motor generator plant, &c., at Barton Power Station.—Bruce Peebles and Co., Ltd.

Sub-contractors: Rotor starter and switchgear for motor, G. Ellison and Co.; shunt-field regulator and generator, Bray, Markham & Reiss.

One battery "milking" motor-generator and switchgear, &c.—General Electric Co., Ltd.

One pressure-testing motor-generator and switchgear.—Electric Construction Co., Ltd.

Salford.—Electricity Committee.

One 150 kVA transformer, £300; one 600 kVA ditto, £1,182; one 6,600 V switch cubicle, £266; spare and rotor parts for No. 2 turbo-alternator, £4,400.—Metropolitan-Vickers Electrical Co., Ltd.

Stirling.—Town Council. Electrical work for 12 months; W. and T. Marshall.

Turbine Furnace Contracts.—The Turbine Furnace Co., Ltd., of 5, Budge Row, London, E.C. 4, have received an order for two sets of turbine furnaces for Babcock type boilers, from the Hexham Electricity Supply Co., of Hexham.

Wellingborough.—Board of Guardians. Cable and electric light wiring, laundry; Wellingborough Electric Supply Co., £170.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, January 7th. At the Caxton Hall, Westminster. At 8 p.m. Lecturette on "The Indicator: Its Use and Application," by Mr. H. G. Pusey.

Friday, January 14th. At Caxton Hall, Westminster, S.W. At 8 p.m. Chairman's address, "The Tides: Their Cause, Effect and Use," by Mr. B. E. Dunbar Kilburn.

Birmingham and District Electric Club.—Saturday, January 8th. At the Grand Hotel, Colmore Row. At 7 p.m. Presidential address, by Mr. A. C. Wynne.

Royal Institution of Great Britain.—At Albemarle Street, W. At 3 p.m. Christmas Lectures—"The Haunts of Life"—by Prof. J. Arthur Thomson:—Saturday, January 8th. "The Conquest of the Land."—Tuesday, January 11th. "The Mastery of the Air."

Institution of Post Office Electrical Engineers (London Centre).—Monday, January 10th. At the Royal Society of Arts, John Street, Adelphi. At 5.30 p.m. Paper on "Four-wire Telephonic Repeater Systems," by Mr. C. Robinson.

Electricity Commissioners.—Tuesday, January 11th. At the Town Hall, Bristol. Inquiry with regard to the West of England Electricity District.

Institute of Marine Engineers.—Tuesday, January 11th. At the Institute, the Minories, E. At 6.30 p.m. Paper on "Electronomy," by Mr. W. B. Sayers.

Association of Engineers-in-Charge.—Wednesday, January 12th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Paper on "Pulverised Fuel," by Capt. F. S. Shaw.

British Ignition Apparatus Association.—Wednesday, January 12th. At the Trocadero Restaurant, Piccadilly Circus, W.1. At 7.30 p.m. Annual dinner.

Manchester Wireless Society.—Wednesday, January 12th. At the Albion Hotel. At 7.30 p.m. Discussion on "High Frequency Currents." To be opened by Mr. J. McKernan.

Paisley Association of Electrical Engineers.—Wednesday, January 12th. At the Technical College, George Street. At 7.30 p.m. Paper on "The Progress of Lighting," by Mr. C. J. Gregg.

Royal Society of Arts.—Wednesday, January 12th. At John Street, Adelphi, W.C. At 8 p.m. Lecture on "Industrial Fatigue," by Dr. C. S. Myers, F.R.S.

Chelmsford Engineering Society.—Thursday, January 13th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Polyphase Induction Motors," by Mr. P. Huggins.

Belfast Association of Engineers.—Thursday, January 13th. At the Municipal Technical Institute. At 6.45 p.m. Paper on "Railway Construction in France during the War," by Major R. M. McCreary.

Institution of Electrical Engineers.—Thursday, January 13th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Twelfth Kelvin Lecture, "Electrons," by Sir Wm. Bragg, F.R.S.

North-Midland Centre.—Tuesday, January 11th. At the Hotel Metropole, Leeds. At 7 p.m. Visit of the President, Mr. L. B. Atkinson.

Scottish Centre.—Tuesday, January 11th. At the North British Station Hotel, Edinburgh. At 7 p.m. Paper on "Range of Wireless Stations," by Capt. R. C. Trench.

Dundee Sub-Centre.—Monday, January 10th. At the University College Engineering Department. At 7.30 p.m. Lecture on "Electric Driving of Jute Factories," by Mr. W. Sutcliffe.

South-Midland Centre.—Wednesday, January 12th. At the University, Birmingham. At 7 p.m. Ordinary Meeting.

Scottish Centre (Students' Section).—Friday, January 14th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "Alternating Current compared to Direct Current for Distribution and Supply," by Mr. R. R. Birch.

Edinburgh Electrical Society.—Friday, January 14th. At the Philosophical Institute. At 8 p.m. Paper on "Some Notes on Cables," by Mr. W. F. Mitchell.

National Association of Supervising Electricians.—Saturday, January 15th. At the Holborn Restaurant. At 6.30 p.m. Annual dinner.

The Electrical Contractors' Association.—Wednesday, January 19th. At the Connaught Rooms, Great Queen Street, W.C.2. Annual dinner.

NOTES.

The "Electrical Review" Index.—The Index to Vol. LXXXVII of the ELECTRICAL REVIEW, which will shortly be printed, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 6d., post free. Any reader or advertiser, at home or abroad, who requires a copy for binding or for other purposes, is asked to make early application therefor to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

British Oil.—At the recent meeting of Messrs. Oilfields of England, Ltd., it was stated that drilling for oil had begun at Kelham, Notts.

An isolated "pocket" of oil has been struck at Heath, near Chesterfield, in the same district as Hardstoft, where oil has been flowing slowly since May, 1919.

A British company is reported to have obtained oil concessions in Thrace from the Greek Government.

Correction.—In our leaderette on "Electric Supply Agreements with Local Authorities," on p. 834 of our last issue, the ninth line from the end was accidentally dropped. The sentence should read: "It was apparently supposed by the local authority in making the agreement that it had authority to indicate to the Supply Company what it should charge private consumers."

Fire.—A fire occurred at Messrs. Crompton & Co.'s works at Chelmsford on Tuesday night, an isolated building, used as an oil and paint stores, and its contents, being partially burnt out. The manufacturing shops were not affected and no delay will be occasioned to the orders in hand.

Service Notes.—It is officially intimated that Naval electricians who are within three years of completing their service for pension, or within three years of completing their first engagement, and do not wish to re-engage, will not be required to requalify at the Torpedo School. Should they decide to re-engage they will have to re-qualify. The following warrant telegraphists have been appointed to the ships named:—Mr. G. Cadman, to the destroyer *Stuart*, flotilla leader; Mr. C. E. Robson, to the *Victory*, Nelson's old flagship at Portsmouth; and Mr. R. P. MacDonald, to the destroyer *Spencer*—all from New Year's Day.

Educational.—VEHICLE DRIVERS' EXAMINATIONS.—The fifteenth annual examinations, organised by the Commercial Motor Users' Association, with the object of encouraging drivers to take a personal interest in the driving and condition of their vehicles, will be held during the last week of April next, says *The Times*. Hitherto confined to London and the Home Counties, these examinations will now be open to any driver in Great Britain, and will be held in various provincial centres. They will be divided into three classes, each with sub-classes for steam, petrol, and electric vehicles. Full particulars may be obtained from the General Secretary of the Association, 50, Pall Mall, S.W. 1.

Six Chinese naval officers are taking a two years' course in practical wireless telegraphy at the Marconi works at Chelmsford.

Fatalities.—On December 24th, an employé of Messrs. Jonas & Colver, Ltd., of Sheffield, named Booth, was cleaning a part of a high-pressure switchboard, when he fell, and came into contact with the "live" portion of the board, with fatal results. The firm was subsequently charged at Sheffield City Police Court with negligence, in that the power was allowed to be on the board while work was being carried out. The firm pleaded "Not guilty," and stated that the deceased man should have spoken to his superior before attempting to go inside the switchboard "cage." A fine of £30 was imposed.

While Alexander William Burnside (24), an electrician, residing in Leith, was engaged measuring a wall at the sub-station of the Atlas Steel Foundry, Rathgate, his head came in contact with a charged wire, which caused instantaneous death.

The Housing Problem and Smoke Abatement.—The Ministry of Health has issued an interim report of the Committee on Smoke and Noxious Vapours Abatement (Cmd. 755, price 2d. net), which has been submitted with a view to securing the adoption of improved methods of heating in connection with the great housing schemes which are now in progress. This Committee was originally appointed in 1914, but its operations were interrupted by the war; it was reappointed in January last.

The report points out that at least 50 per cent. of the total smoke nuisance is due to domestic chimneys—even in industrial areas—and that domestic soot is more deleterious than factory soot, because it contains more tar. Evidence is quoted showing that smoke has a serious effect on the health of the community, on the growth of plants, on live stock, and on buildings. The extra cost of household washing in Manchester, compared with Harrogate, allowing for the difference in population, is stated to be no less than £290,000 a year for fuel and materials alone, disregarding labour. Various methods of heating are considered, and electricity is commended for cooking and heating, but "the high price at present charged for electricity in many localities" is regarded as an objection to its adoption; no mention, however, is made of the high price of coal and gas, or of the fact that the *relative* cost, and not the absolute cost, should be considered. Central heating by steam or water is commended; it has been carried out in some important housing schemes. Where the heating installation is concentrated, the cost is said to be almost the same as the cost of a separate installation in each house, and the upkeep and running expenses can be covered by a rent charge of 1s. per house per week, which in the case of tenement houses or blocks can be reduced to 6d. It is recommended that not more than one coal grate should be installed in any house built with the aid of the Government subsidy, and that the Central Housing Authority should decline to sanction any scheme in which specific provision is not made for the adoption of smokeless methods of supplying heat; the practice followed by some municipal authorities of overcharging for gas and electricity in order to secure profits for the relief of the rates is condemned.

We may remark that the use of electricity in connection with many of the new housing schemes is hindered by the low prices quoted by the gas suppliers for equipment, doubtless with the intention of recouping themselves by way of the charges for gas, whilst on the other hand electricity supply authorities are not making efforts to meet this form of competition by offering a low tariff for heating and cooking. We commend to the notice of the latter the admirable example of the North-East Coast companies, whose electric houses at Billingham were described in our issue of October 29th, 1920. Material economies can be effected in the cost of the buildings by the omission of fireplaces and flues, and the provision of electrical apparatus for heating and cooking, as well as, of course, for lighting, should add very considerably to the attractions of the new houses.

Russian Scientists.—We have received from the British Committee for Aiding Men of Letters and Science in Russia, a letter inviting subscriptions to a fund for providing literary and scientific men in Russia with the works they need; they have seen no European publications since the revolution. Cheques made out to the Treasurer, Mr. C. Hagberg Wright, should be addressed to the above Committee at the British Science Guild Offices, 6, John Street, Adelphi, W.C. 2.

The Federated American Engineering Societies. — At the first meeting of the Council on November 19th, Mr. Herbert Hoover, former Food Administrator and president of the American Institute of Mining and Metallurgical Engineers, was elected president of the governing body, the American Engineering Council. The meeting was attended by delegates from all but one of the 21 charter-member societies and by some representatives of bodies that expect to become charter members.

One of the first activities of the new body will be a survey under Mr. Hoover's direction to determine quantitatively the amount of waste motion in industry. Included in this survey will be the threefold waste in production occasioned by (1) intermittent employment, (2) non-employment arising in shifting industrial currents, and (3) strikes and lockouts.

It was decided to elect only 20 members of the executive board of the Council, leaving four vacancies to be filled by other societies which might later become charter members. On the basis of membership the national societies were entitled to 14 members on the board and the local regional and State organisations to the remaining six places by districts. Washington, D.C., was chosen as the place to establish headquarters. It was decided to extend until July 1st, 1921, the time within which societies may become charter members.

A report by the committee on plan and scope indicated a number of activities, many of which were inherited from the Engineering Council, in which the new organisation could well engage. The executive board appointed Mr. L. P. Alford as its temporary secretary.

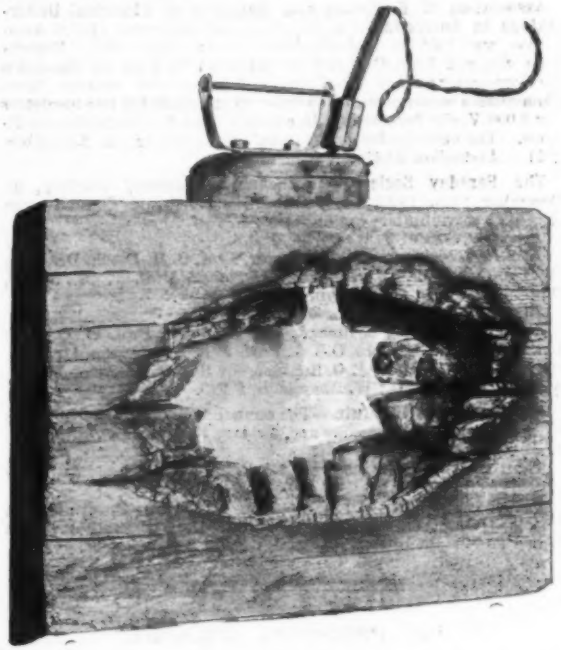
It is reported that the American Society of Civil Engineers, which voted not to become a charter member of the Federated American Engineering Societies, has taken steps to hinder the functioning of the new American Engineering Council of the Federation by trying to perpetuate the old Engineering Council.

British and American Generating Practice.—One of the main objects of the recent tour of the U.S.A. which was made by Alderman Dagnall, chairman of the Manchester Electricity Committee, and Mr. S. L. Pearce, the city's electrical engineer, was, says the *Manchester Guardian*, to ascertain if any desirable points in American practice could be incorporated in the design of the new Barton generating station. In an interview which Mr. Pearce gave to a representative of the above-mentioned newspaper, he is reported to have said that whilst he came across many features that could be embodied in the Barton scheme, he saw nothing to induce him to fundamentally alter the lay-out. The station with its 150,000 kw. total capacity compares with the Duquesne station, at Pittsburg, U.S.A., of 360,000 kw. ultimate capacity supplied by six 60,000-kw. sets. Large American generating sets have not been a complete success, and there is a tendency to proceed more slowly and generate with sets of a more moderate capacity. The explanation given was inability to obtain proper materials during the war period. No faults in design are admitted, but Mr. Pearce is not prepared to accept that statement. He, however, states that the Americans are much keener on extracting the utmost power from their boiler houses. There is much likelihood, Mr. Pearce thinks, that pulverised coal will become the boiler fuel of the future. Americans are awaiting the results of the trials in the Milwaukee stations; in Manchester they may wait, or investigate on their own at Stuart Street later on. "It is certainly a thing we shall have to consider."

"Another matter that interested me," said Mr. Pearce, "was the public steam-heating systems in many American cities, particularly in New York and Detroit. We have done a little bit of warehouse and office block heating from Dickinson Street with exhaust steam, and have tried to make it a by-product supply from the power station. They started in exactly the same way in the States, but they found out, as we found out, that it is next to impossible to run the supplies of electricity and steam together, because the loads are not coincident with the times of demand. In America they have now independent steam-heating stations, owned and controlled in some cases by the electrical companies." Mr. Pearce sees no reason why something of the sort should not be done in Manchester, though the great difficulty would be to find room under the streets for the steam pipes; however, the boilers at the Dickinson Street station could well be used for the purpose when that station ceased to be required for generating purposes. It would be difficult to dogmatise from American experience as the conditions there were so different. The electrical undertakings in the States were operated by companies—it was an exception for the municipality to own and control the public utility services—and in all interconnecting schemes the companies acted in a spirit of voluntary co-operation. A striking example was in Ohio where something like 500,000 kw. of power was interconnected. The outstanding scheme, however, was the interconnecting of the whole of the electrical undertakings on the Atlantic seaboard from Maine to Washington—an area 400 miles long and 150 to 200 miles wide. "The thing that struck me," said Mr. Pearce, "was that it apparently paid certain undertakings to shut down their own plant and buy power from stations 80 or 90 miles away." In cable transmission, said Mr. Pearce, America was 10,000 volts behind this country in pressure—33,000 against 33,000—but overhead transmission there ranged from 33,000 volts to 165,000 volts, and contracts had been placed for overhead lines to operate at 220,000 volts. This country, however, was much restricted in the use of overhead transmission, and whilst not ruling out entirely the possibility of its use in South-east Lancashire, Mr. Pearce expressed the opinion that it would be found possible to use the cable system for higher pressures than 33,000 volts. He doubted whether the requirements of the particular area would ever call for a higher transmission voltage than 66,000. The transformer sub-station in the States, Mr. Pearce proceeded, was usually of the outdoor type, and the apparatus was built to withstand all atmospheric conditions. No buildings were required. Manchester would no doubt adopt the system to a limited extent. America's choice in converter substations was between two types—the remote controlled and the entirely automatically operated—the object of both designs being to cut down operating expenses. It was almost uncanny to see in those converter stations machinery working with the same certainty of proper movement as if a skilled attendant were in charge. America, generally speaking, was very keen on automatic control, and the human agency in the working of telephones was being replaced as quickly as the newer system could be installed. Enormous contracts were in hand all over the United States.

An interim report by Ald. Dagnall and Mr. Pearce, very much on the same lines as the foregoing, was received and approved by the Electricity Committee on January 5th.

A Remarkable Test.—To convince an Australian buyer of the efficiency and durability of their "Elect" iron, the Electric Heating Co., George Street, Croydon, arranged the following test:—A 6-lb. iron was mounted on a wood plank 14 in. wide and 4½ in. thick, and the current was switched on. In 13 hours the iron, which had become a white-hot mass of metal, had burned its way through the board, and although the wooden handle was destroyed and the nickel plating removed, the element was as sound as before the test and the following day a pint of water was boiled on the iron.



The illustration shows the board and the iron after the test. We are told that the test was successful in convincing the buyer of the excellence of the "Elect" iron.

Water-Power Notes.—Some useful notes on the points to be taken into consideration when choosing sites for water turbines are given in a leaflet issued by Sir W. G. Armstrong, Whitworth & Co. The first is the determination of the head, *i.e.*, the vertical distance between headwater and tailwater level, also stating if possible the variations of the head and tail water levels; (2) what h.p. is required, and into how many units the total power is to be divided; (3) available water supply in cubic feet per second; (4) is there always sufficient water, or is the supply liable to run short? (5) is the water supply clean, or does it contain sand or other foreign matter? (6) what has the turbine to drive, and is there any particular desire for a special speed? (7) is a horizontal or vertical shaft turbine required (bevel gears must be avoided if possible)? (8) is the water led to the turbine through a pipe line or an open flume? (9) how long is the pipe line, and is the diameter decided upon? (10) what is the height from the turbine to low water level (the suction head for Francis turbines ought not to exceed 20 ft. vertical. The altitude at which the turbine is to be installed is a factor)? (11) if possible give a sketch showing the site, and also one showing the position of the power station in connection with the pipe line, flume, tail race and dam; (12) in the case of small units, is an oil pressure governor required, or will regulation by hand be resorted to?

Appointments Vacant.—Borough electrical engineer (£400), for the Limerick Corporation; charge engineer, for the Paisley Corporation Electricity Department; teacher of electrical engineering, for the East Ham Technical Institute Evening Classes; accounts clerk (£234), for the Wolverhampton Borough Council Electricity Department; relief charge engineer (80s. + war bonus, at present total remuneration about £8 5s.), for the L.C.C. Tramways Department; junior assistant, for the Borough of Bacup Electricity Department; gas engine attendant and electrician, for the Sheffield Water Works; temporary charge engineer (1s. 11½d.), for the Aldershot Urban District Council Electricity Works; plumber-jointer, for the Stepney Borough Council Electricity Department; assistant engineer (£300), for King's College Hospital; l.t. plumber-jointer, for the Wolverhampton Corporation Electricity Department. See our advertisement pages to-day.

INSTITUTION NOTES.

Institution of Electrical Engineers.—INFORMAL MEETING.—An additional informal meeting will be held on January 24th, for the purpose of discussing in what ways the Institution can be made more useful to its members. This will give an opportunity to members who made suggestions at the recent meetings in connection with the increase of subscriptions to put forward their views on the subject.

As it is expected that the attendance at this meeting will be larger than usual, arrangements have been made for it to be held at the Institution of Civil Engineers, at 6 p.m. (instead of at the Chartered Institute of Patent Agents, 7 p.m.).

NORTH MIDLAND CENTRE.—At the first meeting of the 1920-21 session of the above Centre, which was held on December 14th, the chairman, Mr. C. J. Jewell, announced that Mr. Ll. B. Atkinson, president of the Institution, had promised to address the members of the Centre at Leeds on January 11th.

Association of Engineers and Managers of Electrical Undertakings in Australia.—The third annual Conference of this Association was held in Adelaide, from October 5th to 8th. Reports were received from Committees appointed to draw up standards or low-pressure line insulators and consumers' service fuses. Committees were appointed to draw up standards for line insulators or 6,000 V, also for standard line construction for Australian conditions. The next Conference is to be held at Hobart, in November, 1921.—*Australian Mining Standard.*

The Faraday Society.—At the annual general meeting, on December 13th, 1920, the following officers and Council were elected to serve for the coming year:—

President.—Prof. F. W. Porter, F.R.S.

Vice-Presidents.—Mr. W. R. Cooper, Prof. C. H. Desch, Dr. J. A. Harker, O.B.E., F.R.S., Mr. Emil Hatschek, Prof. T. M. Lowry, C.B.E., F.R.S., Dr. E. H. Rayner, Dr. G. Senter.

Treasurer.—Mr. Robert L. Mond, F.R.S.E.

Council.—Dr. A. J. Allmand, Dr. H. Borns, Prof. W. C. McC. Lewis, Mr. Harold Moore, O.B.E., Prof. J. R. Partington, Mr. C. C. Paterson, O.B.E., Prof. A. O. Rankine, Sir Robert Robertson, F.R.S., Sir T. Kirke Rose, Dr. W. Rosenhain, F.R.S.

Iron and Steel Institute.—The annual meeting of the Institute will take place on Thursday and Friday, May 5th and 6th, at the Institution of Civil Engineers.

The latest date for receiving applications from candidates for election is March 10th.

The annual dinner will be held on May 5th, at the Connaught Rooms, Great Queen Street, W.C. Particulars of the cost of the dinner and details of the arrangements will be circulated later.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

The New Year Honours.—Amongst the recipients of honours in the list published on January 1st we notice the following:—SIR W. BEARDMORE, Bart., to be a baron; SIR JOSEPH HEWITT to be a baronet, for notable services rendered in the Coal Controller's Department; MR. P. R. RYLANDS, President, and MR. E. F. OLDHAM, Deputy Chairman, of the Federation of British Industries, MR. A. R. DUNCAN, Coal Controller, and CAPT. L. DE L. WELLS, late Chief Officer of the Metropolitan Fire Brigade, to be knights; COL. J. W. PRINGLE, Chief Inspecting Officer of Railways, Ministry of Transport, to receive the C.B.; MR. G. R. CLARKE, O.B.E., Indian Civil Service, Director-General of Posts and Telegraphs, to receive the C.S.I.; MR. W. H. MASSEY to receive the M.V.O. (Fourth Class). Practically every profession except engineering, as usual, is well represented in the list; in fact, Sir W. Beardmore and Mr. Massey appear to be the only members of the engineering fraternity whose names are in the list.

On December 31st SIR THOMAS WILLIAMS retired from the post of general manager of the L. & N.W. Railway. He will become a member of the Board of Directors. Asked by a representative of *The Times* what he considered the most far-reaching change in the railway in his experience of nearly 50 years, he said that this was the electrification of the line to Watford. His successor is MR. ARTHUR WATSON, of the L. & Y. Railway.

Halifax Tramways Committee, in re-affirming a previous decision (referred back by the Town Council) to appoint MR. J. W. GALLOWAY, tramway engineer, as general manager, at a salary of £700 for one year—the matter then to be re-considered—has also recommended that £250 per annum, for three years, be paid to MR. J. D. CAIRD, traffic manager, who is not, in consequence of illness, fit to resume his duties, and that at the expiration of such period the question be reviewed.

Bolton Town Council General Purposes Committee has decided not to grant applications made by Corporation officials in the electricity, tramway, and other departments for increases of salary, on the ground that the position was sufficiently met by the grant of the Civil Services war bonuses recommended by the National Whitley Council last May.

MR. H. CAREY-THOMAS, A.M.I.E.E., has been appointed to a commission in the Regular Army, with the rank of Captain, for duty with the Royal Corps of Signals. Captain Carey-Thomas, who held a commission prior to the war in the London Army Troops, R.E. (T.F.), served in France continuously from October, 1914, to May, 1918, and was mentioned in Lord (then Sir John) French's dispatch of January, 1916. In May, 1918, he was appointed Assistant Director of Army Signals at G.H.Q. the Forces in Great Britain, with the rank of Lieut.-Colonel, and at a later date held the appointment of Chief Signal Officer, H.Q. Western Command, Chester.

MR. R. H. CRIDGE, B.Sc.(Eng.), has left Messrs. Electro-Metals, Ltd., and joined the Harding Co. as a specialist in pulverised coal and industrial grinding.

Stepney Borough Council General Purposes, Staff and Education Committee recommends that in consideration of the extra work performed for the electricity undertaking by the borough treasurer, a sum of £100 per annum be paid to him as from April 1st last; and that in lieu of the salary and bonus now being paid to MR. A. J. SQUIRE, the deputy commercial manager in the electricity supply department, he be paid a consolidated salary of £700 per annum, as from June 1st, 1920, rising by annual increments of £25 to £750.

Obituary.—MR. C. J. GALE.—The death occurred on December 29th, of Mr. C. J. Gale, secretary of the Topsham E.L. Co., Ltd. He was 55 years of age, was a member of the Topsham Parish Council, and a Past-Master of the Brent Lodge of Freemasons.

NEW COMPANIES REGISTERED.

G. W. Higgins & Sons, Ltd. (172,253).—Private company. Registered December 24th. Capital, £3,000 in £1 shares. To carry on the business of shop fitters, cabinet makers, upholsterers, builders, painters, decorators, sanitary and electrical engineers, &c. The permanent directors are: G. W. Higgins (governing director and chairman), 22, Connaught Street, W.2; S. G. Higgins (managing director), 33, Pope's Grove, Strawberry Hill; Mrs. F. Higgins, 22, Connaught Street, W.2. Registered office: 34, Connaught Street, W.2.

Controls, Ltd. (172,218).—Private company. Registered December 23rd. Capital £1,000 in £1 shares. To carry on the business of makers of and dealers in flexible wire and rod controls, throttle and ignition controls for internal combustion engines, gear and brake controls for automobiles, motor and other cycles, aircraft, ship telegraphs, and switchboards, mechanical, electrical, and consulting engineers, &c. The subscribers (each with one share) are: W. Mair Rolph, 66, Piccadilly, W., engineer; F. Hay, 9, Lincoln's Inn Fields, W.C., solicitor. W. M. Rolph (director of Hatchetts White Horse Cellars, Ltd., Simms Motor Units (1920), Ltd., Standard Insulator Co., Ltd., and Gerrett & Co., Ltd.) is permanent governing director, with £300 per annum as remuneration. Secretary: L. S. Thompson. Registered office: 66, Piccadilly, W.

Women Engineers.—Atalanta, Ltd., has been registered with a nominal capital of £10,000 in £1 shares. The objects are: To carry on the business of manufacturers of and dealers in automobiles, motor and other cycles, carriages, and electrical appliances, engineers, founders, smiths, machinists, &c. The formation of the company was suggested by members of the Women's Engineering Society, to utilise the available services of women skilled in different branches of the engineering profession. The first directors are: Hon. Lady Katherine Parsons, 6, Windsor Terrace, Newcastle-on-Tyne; Hon. Lady Eleanor G. Shelley-Rolls, 21, Eaton Square, S.W.; Miss Caroline H. Haslett, 46, Dover Sreet, W. (secretary of Women's Engineering Society); Miss Annette Ashberry, 139, Ashby Road, Loughborough; Miss Dora W. Turner, 139, Ashby Road, Loughborough; H. Scofield, M.B.E., &c., The Technical College, Loughborough; W. P. Johnson, A.R.C.Sc.(Lond.), &c., The Technical College, Loughborough. Minimum cash subscription, 60 per cent. of the shares offered to the public. Secretary: Miss Dora W. Turner. Solicitor: R. J. Evans, Midland Chambers, Princess Street, Wolverhampton. The office is at Atalanta Works, Selbourne Street, Loughborough.

George Nobbs, Ltd. (172,328).—Private company. Registered December 30th. Capital, £5,000 in £1 shares (3,000 8 per cent. cumulative preference). To carry on the business of manufacturers of and dealers in electrical appliances, &c. The subscribers are: C. G. Nobbs, 50 West Heath Drive, Hampstead, N.W.11, electrical engineer (1,000 ordinary shares); Mrs. F. E. Nobbs, 50 West Heath Drive, Hampstead, N.W.11 (5 ordinary shares). C. G. Nobbs is permanent governing director. Registered office: 89, Cleveland Street, W.1.

C. A. Besley, Bailey & Co., Ltd. (172,282).—Private company. Registered December 28th. Capital, £6,000 in £1 shares. To take over the business of C. A. Besley, Bailey & Co., of Hope Street Lane, Cardiff, and to carry on the business of electrical, telephone, heating, sanitary, hydraulic, motor, gas, ventilating, railway, constructional, and general engineers, &c. The first directors are: F. Morgan, Dowlais Arcade, Cardiff; A. Jones, Dowlais Arcade, Cardiff; C. D. Esnouf, 14, West Bute Street, Cardiff; V. A. Bailey (managing director), Hope Street Lane, Cardiff. Solicitor: L. Francis, 12, Dumfries Place, Cardiff.

Globe Engineering Co., Ltd. (172,285).—Private company. Registered December 28th. Capital, £5,000 in £1 shares. To take over the business of electrical engineers carried on by Barraclough Bros., Ltd., at Perseverance Mills, Brighouse. The first directors are: R. M. Brooke, Elstree, Savile Road, Elland; A. Dean, 20, Elizabeth Street, Elland; A. M. Lawry, 28, Heath Crescent, Halifax. Registered office: Perseverance Works, Huddersfield Road, Brighouse.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Dale & Hardy, Ltd.—Charge on certain moneys due under a contract, dated December 9th, 1920, to secure all sums due or to become due from company to the charges for goods, sold and delivered by them. Holders: Samuel Cutler & Sons, Ltd., 39, Victoria Street, Westminster.

Rhondda Tramways Co., Ltd.—Satisfaction to the extent of £5,400 on December 9th, 1920, of charges dated March 24th, 1911, November 13th, 1912, and March 11th, 1915, securing £250,000.

Radio Communication Co., Ltd.—Satisfaction to the extent of £15,000 on November 23rd, of mortgage dated April 28th, 1920, securing £5,000, and further advances up to a maximum of £15,000.

Laminated Gears, Ltd.—Issue on December 16th, 1920, of £600 debentures, part of a series already registered.

Hale, Pearn & Co., Ltd.—Satisfaction in full on December 23rd, of mortgage dated January 27th, 1920, securing £3,600.

Electric Supply Co. of Victoria, Ltd. (66,059).—Capital £325,000 in 175,000 preference and 150,000 ordinary shares of £1 each. Return dated October 27th, 1920. 175,000 preference and 125,000 ordinary shares taken up. £50,007 paid. £249,993 considered as paid. Mortgages and charges, £118,358.

Salford Electrical Industries, Ltd. (112,599).—Capital £20,000 in 10,000 preference and 10,000 ordinary shares of £1 each. Return dated November 30th, 1920. All shares taken up. £10,000 paid on the preference. £10,000 considered as paid on the ordinary. Mortgages and charges, nil.

Anglo-Russian Engineering Co., Ltd.—Satisfaction to the extent of £500 on November 24th of debentures dated January 17th, 1917, securing £2,000.

CITY NOTES.

Edison Swan Electric Co., Ltd.

The directors' report for the year ended June 30th, 1920, states that the profit for the year was £111,570, plus £61,710 brought forward, making £173,281, out of which the following payments have been made:—

Interest on both classes of the debenture stock	£17,100
Seven per cent. dividend on participating preference shares to January 31st, 1920	7,000
Excess profits duty to June 30th, 1918, less munitions levy refund ...	16,615

The balance of £131,976 is to be appropriated as follows:—

Special munitions plant depreciation	2,844
Expenses of issue of ordinary shares	10,000
Transfer to reserve	5,000
Dividend of 3 per cent. on participating preference shares (making 10 per cent. for the year)	3,000
Provision for debenture stock sinking fund	5,978
	26,822
To be carried forward, subject to excess profits duty from June 30th, 1918, and corporation profits tax	105,154
	131,976

During the year under review the sum of £127,550 has been expended upon capital account, of which £460 is in respect of additional building land, £78,268 on buildings, and £48,822 on plant and machinery. Extensive additions have been made to the lamp works, mainly to provide for the manufacture of gasfilled half-watt lamps; the expenditure upon these buildings and their equipment amounts to £91,169.

In the early part of this year the board entered into an arrangement with Messrs. Philips' Glow Lamp Works, Ltd., of Eindhoven, Holland, whereby it has been able to obtain the co-operation of that firm at the Edison-Swan works at Ponders End in the manufacture of all classes of electric lamps. The Philips' Glow Lamp Works, Ltd., possesses processes, plant, and machinery which have hitherto enabled it to manufacture lamps on the most economical basis, and of the very highest quality. Similar plant, machinery, and processes have now been installed for some months at the Ponders End works of the Edison-Swan Co., and although the benefits derived from this installation do not, at the date of the balance sheet, reflect in the profits, they are becoming apparent, and should very considerably increase the profits in the future. The directors are satisfied that the arrangement made with the Philips' Glow Lamp Works, Ltd., will prove beneficial to the company, and under the terms of the agreement a separate company will be formed for the entire manufacture of electric lamps for the Edison-Swan Co., the necessary capital being equally contributed by the Edison-Swan Co. and the Philips' Co.

Arrangements have been entered into with the Sangamo Electric Co. of the United States, manufacturers of high-class electric meters, which they are producing on an extremely economic basis, and which command a ready sale in all parts of the world. Under this arrangement a company is being formed in conjunction with the American firm, the capital being subscribed by that firm and the Edison-Swan Co., to manufacture similar meters at the Ponders End works of the Edison-Swan Co., buildings having been erected for the purpose at a cost of £25,000.

During the period of the war and for some considerable time after the cessation of hostilities, the stocks of raw materials and manufactured goods had fallen very low, and in order to efficiently carry on the company's operations it has been found necessary to very largely increase these. For this reason, coupled with the heavy expenditure on new buildings, plant, &c., the prospective employment of further large sums in lamps, electric meters, and other stocks, it is necessary that additional capital should be provided. The position of the money market, however, is not sufficiently favourable to allow of an immediate issue, but so soon as it is possible it will be made. In the meantime it is necessary that the cash resources of the company should be conserved, and under these circumstances the directors regret that they are not able to recommend the payment of a dividend upon the ordinary shares, and they, therefore, propose to carry forward the sum of £105,154, which will be subject to excess profits duty and corporation profits tax. Should the financial position become more liquid, the directors may be in a position to declare a compensating interim dividend before the termination of the financial year.

French Companies.

The Etablissements Maljournal et Bourron report a gross profit on the working year of 6,139,140 fr., and a net profit of 1,345,789 fr., which, with the sum carried over from the previous year, yields an available balance of 1,360,907 fr. (against 775,707 fr. for the year 1918-1919). Out of this a dividend equal to that of the foregoing year is declared, namely, 12 fr. per share. All the items of the company's balance sheet show improvement, the aggregate for the year totalling 25,620,248 fr., against 17,943,365 fr. in 1918-1919.

The Syndicat des Mécaniciens, Chaudronniers et Fondeurs de France has published a resolution passed at a previous meeting that its manufacturing members, in dealing with their customers, were ready to return to all the usages of credit customary before the war, notably in the matter of accepted bills of exchange, presuming, of course, reciprocal equality of treatment on the part of their clients. To render this step effective the stamp duty (0.20 fr. per cent.) should, it says, be reduced, which would result in a larger return from this duty by reason of the greater volume of business which would result from the reduction. The Syndicat is an important body, numbering a thousand members scattered all over France, and employing over 250,000 workmen. The Lyons Chambre de Commerce and the chairmen of the Parisian Chambers have likewise drawn the Government's attention to the effect of this tax on restricting trade and the need for restoring complete freedom to commerce. Only measures of this kind, it is held, can stave off the oncoming general commercial breakdown.

German Companies.

The Brasilianische Elektrizitats Gesellschaft, of Berlin, which has a share capital of 5,000,000 marks, and whose assets are represented by the telephone system in Rio de Janeiro, reports general expenses and taxes in Berlin amounting to 158,000 marks for 1919-20, which sum has been debited to the Rio de Janeiro Tramway, Light & Power Co. The accounts show no profits, and a dividend has not been paid since 1915-6, when the shares were disposed of to a Canadian company.

The report of the *Berlin Elektrizitats Werke A.G., of Berlin*, whose activity is now limited to that of acting as a trust for the A.E.G., states that the undertakings which the company is interested in yielded satisfactory results in 1919-20. These include the Leopold Colliery, the Bitterfeld Electrochemical Works, and certain supply companies. The accounts indicate net profits of 5,788,000 marks, as contrasted with 4,781,000 marks in 1918-19, and the dividend is at the rate of 10 per cent., as against 8 per cent. in the previous year.

The shareholders in the *Rheydt Cable Works Co.* have just sanctioned an increase in the share capital of 10,000,000 to 25,000,000 marks. At the recent general meeting it was stated that the augmentation was rendered necessary by the general development of affairs, and as an instance it was mentioned that while a stock of from 500 to 600 tons of copper cost 600,000 marks before the war, a sum of from 15 to 18 millions of marks was now required for the same quantity. It was also stated that business had become more active in the past few weeks, and orders were now on hand for several months forward.

Stock Exchange Notices.—Dealings in the following securities have been specially allowed by the Committee under Temporary Regulation 4 (3):—

General Electric Co.—78,641 ordinary shares of £1 each, fully-paid, Nos. 2,033,335 to 2,111,975; and 22,891 7½ per cent. "B" preference shares of £1 each, fully-paid, Nos. 1,600,001 to 1,622,891.

The Committee has ordered the following to be officially quoted:—

British Electric Transformer Co.—137,500 7 per cent. cumulative preference shares of £1 each, fully paid, Nos. 325,001 to 462,500.

Provincial Tramways, Ltd.—Final dividend of 10d. per share (making 7½ per cent.) on the ordinary shares for the year ended September 30th. £10,000 is placed to reserve and depreciation account, and £10,000 is provided for excess profits duty.

Victoria Falls & Transvaal Power Co., Ltd.—Dividend at the rate of 6 per cent. per annum, less tax, on preference shares for the six months.

British Electric Transformer Co., Ltd.—Profits for the half-year ended June 30th last were £36,344, as compared with the corresponding period in 1919 of £21,419.

STOCKS AND SHARES.

TUESDAY EVENING.

THE New Year opened with strength in most of the Stock Exchange markets. There was a better tendency shown amongst the majority of stocks, due doubtless to the fact that money was being released from deposit and current accounts where it had lain, for window-dressing purposes, up to the end of 1920. There is talk in the air of a possible reduction in

the Bank Rate, though in good quarters this revived expectation is treated cautiously. The present 7 per cent. Bank Rate has been in force since last April, and the argument in favour of a reduction in the rate is that such a step would fit in with the Government's programme for stimulating and encouraging trade in order to reduce unemployment.

Buoyancy in the War Loan and other gilt-edged securities constitutes a useful platform from which the general markets of the Stock Exchange can step off to better conditions in the New Year. There is certainly more willingness than was displayed last month on the part of the public to invest money in Stock Exchange securities. Forced liquidation has come to an end for the time being, nor is there much likelihood of its being renewed in the same measure at all events, as characterised the pressure of the last six months. These things make for better markets, and while several ugly niggers remain in the hedge, Stock Exchange opinion is inclined to be optimistic, though tempered by the consideration that too great uncertainty prevails for the House to look for any especial expansion of business in the near future.

The Edison Swan Co. has greatly disappointed its shareholders by passing the dividend for the final six months of the year. Moreover, there is talk of a probable new issue before long. The company's profits for last year came to £111,500 as against £137,400 for the previous twelve months, when 10 per cent. was paid. Once again it is the money position which renders distribution of profits inadvisable. The directors state that should the financial position become more liquid, they may be able to declare a compensating interim dividend before the termination of the current financial year. This latter statement is regarded as being in the nature of consolation, and for its fulfilment everything really depends upon the money position. The company did reasonably well last year, and in the ordinary way there would have been a dividend on the ordinary shares, but, as with the India-Rubber and various other companies which are issuing their reports just now, the necessity for keeping cash in hand over-rides the desirability of paying dividends to shareholders.

This is the kind of thing which it may be feared wil. make itself unpleasantly conspicuous in reports and statements of industrial companies during the next few months. It comes about as the direct result of the deflation which one can see now clearly enough was bound to be one principal feature of war's aftermath. In addition, however, there is the factor of the coal strike to be taken into account. This had the effect of holding up trade for several weeks, not only while the strike itself lasted but for some considerable period previously, when manufacturers and others declined to enter into contracts, or to take on any risks except those which were absolutely necessary, having regard to the struggle forced by the coal-miners.

Amongst the firmer markets which the New Year has brought must be included the market for Home Railway stocks, where numbers of rises have taken place during the past few days. So far, however, Undergrounds have not benefited, and there is not much doing in the stocks of the companies. Underground £10 shares are ¼ lower at 35s.

English Electric 8 per cent. six-year Notes, which were issued at 98, can be bought at 92 or a little cheaper, offering a return on the money of 8¾ per cent., with a full interest payment due on July 1st. The Notes are redeemable in 1927 at 103, or after 1923 at the same price. A similar yield can be obtained from the 5 per cent. debenture stock of the Metropolitan Electric Tramways, which stands at 58, with interest due April 1st and October 1st. Westinghouse Brake 8 per cent. first mortgage debentures, which came out at 95, can be bought at one or two points discount, giving a yield of 8¼ per cent. on the money, and being redeemable at par in 1944 or earlier. There is a sinking fund to be applied to purchases in the market, or to drawings at par. The 4½ per cent. second debenture stock of the Brush Electrical Co. is on offer at 56, affording 8 per cent. on the money, and this is a perpetual security. Calcutta Electric 5 per cent. convertible debentures, which came out at 95, are obtainable at 93¼, giving 5¼ per cent. free of tax, equivalent to 7¾ per cent. on the money, allowing for income tax at 6s. in the £. These carry conversion rights into the ordinary shares, between June, 1922, and June, 1925, inclusive, at the rate of £7 10s. debenture for £5 ordinary shares. In the preference list, General Electric 7½ per cent. "B" shares can be bought at 18s. 9d. ex dividend, paying 8 per cent. on the money, the company's 6½ per cent. "A" preference at 17s. 3d. offering just over 7½ per cent. County of London Electric 6 per cent. preference have come on offer at a little over £8, thus offering 7½ per cent. on the money, with dividends due in March and December. We mention these various issues as showing what is available in the markets for sound securities of the kind which may appeal to those who are putting away money for permanent investment at the beginning of the year.

Brompton ordinary are ¼ down at 5¼. South Metropolitan 7 per cent. preference weakened to 13s. 9d., and the 6 per cent. second preference to 12s. City of London ordinary shares are 1-16 easier at 21s. 3d., and these are the only changes in the electricity supply list. County of London remain at 7½. It is announced that the company is seeking Parliamentary authority to constitute its Barking supply into a separate undertaking. A meeting will be called to take the necessary powers. Amongst the manufacturing shares, Edisons fell to 8s. 9d., on the lack of the dividend, but rallied again to 10s.; the 5 per cent. debenture stock at 70 is ex dividend. Siemens are easier at 20s. 7½d. Babcock & Wilcox went up 3-16 to 2 5-16, and most of the iron, steel and armament shares are disposed to harden. Armstrongs improved to 19s., and Vickers, in which there is apparently a bear position, recovered to 16s. 3d. after dipping to 14s. 6d. the day after the recent meeting.

In the cable group, Great Northerns gave way to 20, but apart from this, the general tendency is decidedly firm. Eastern stocks are all in demand, and it is difficult to get the offer of any reasonable amount at the figures quoted in our lists. Marconis recovered to 2 5-16 ex the dividend. Better prices also have come into force for Radio Common at 9s. 6d., and preferred at 10s. 6d. Other Marconi shares are inclined to be a little better, though without any particular change in the prices.

Anglo-Argentine Tramways first preference are quoted 2¾ ex dividend, and the 5 per cent. debenture is easier at 53½. Mexicans are quiet on the whole. Mexican Light and Power preferred at 22½ is 3 points down, but the first mortgage bonds firmed up to 61½. Other foreigners are unchanged. Dollar stocks have been fluctuating a good deal, and are lower on balance. One of the Stock Exchange features at the moment is a sharp recovery in rubber shares, owing to the suggested Credit Export scheme. This, if established, might have the effect of bringing in the long anticipated buying of rubber from Germany and Austria, to the clearing off of the accumulated stocks of rubber and the re-establishment of the industry on a profitable basis. Many substantial price-improvements have occurred this week, although actual business continues to run on very retail lines.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Jan. 4, 1921.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	5¼	¼	£10 4 4
Charing Cross Ordinary	4	7	8½	—	10 7 4
do. do. do. 4½ Pref.	4½	4½	9½	—	8 8 8
Chelsea	3	4	3½	—	6 8 0
City of London	8	10	1 3/16	— 1/16	9 8 2
do. do. 6 per cent. Pref.	5	6	17/6	—	6 17 2
County of London	7	8	7½	—	10 13 4
do. do. 6 per cent. Pref.	6	6	8	—	7 10 0
Kensington Ordinary	6	7	3⅞	—	9 0 6
London Electric	Nil	2½	1	—	10 0 0
do. do. 6 per cent. Pref.	5	6	2⅞	—	10 18 2
Metropolitan	5	6	2/6	—	11 5 8
do. 4½ per cent. Pref.	4½	4½	2/6 xd	—	8 15 8
St. James' and Pall Mall	10	12	6½	—	9 12 0
South London	5	6	2½	—	9 12 0
South Metropolitan Pref.	7	7	13/9	— ¼	10 3 8
Westminster Ordinary	8	10	4½	—	10 10 6
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	75½	—	7 19 0
do. Def.	33/6	1½	16½	+ ¼	9 10 6
Chile Telephone	5	6	6½	—	*5 9 1
Cuba Sub. Ord.	7	7	7	—	*10 0 0
Eastern Extension	8	10	142	—	*6 15 7
Eastern Tel. Ord.	8	10	153½	—	*6 11 4
Globe Tel. and T. Ord.	8	10	14½	—	*6 15 7
do. do. Pref.	6	6	8½	—	7 1 9
Great Northern Tel.	22	22	20	— ½	11 0 0
Indo-European	13	10	30	—	6 6 8
Marconi	25	25	2 5/16	+ ¼	—
Oriental Telephone Ord.	10	14	2 5/16	—	*5 4 0
United R. Plate Tel.	8	8	5½	—	*6 16 4
West India and Panama	1/3	Nil	1/4	—	Nil
Western Telegraph	8	10	14½	—	*6 15 7
HOME RAILS.					
Central London Ord. Assented	4	4	43½	—	9 4 8
Mesropolitan	1	1½	20	—	6 5 0
do. District	Nil	Nil	15½	—	Nil
Underground Electric Ordinary	Nil	Nil	1½	— ¼	Nil
do. do. "A"	Nil	Nil	5/-	—	Nil
do. do. Income	5	4	60½	—	—
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams, First Pref.	Nil	5½	92 xd	—	10 0 0
do. do. 2nd Pref.	Nil	Nil	3½	—	Nil
do. do. 5 % Deb.	5	5	53½	—1	9 8 6
Brazil Tractions	Nil	Nil	37	—	Nil
British Columbia Elec. Rly. Pfce.	5	5	56	—	8 18 4
do. do. Preferred	2½	5	55½	—	*5 6 9
do. do. Deferred	Nil	3	52½	—	*6 10 10
do. do. Deb.	4½	4½	63½	- 3	7 19 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	37	—1	Nil
do. 6 per cent. Bonds	Nil	Nil	27½	—	Nil
Mexican Light Common	Nil	Nil	16	—	Nil
do. Pref.	Nil	Nil	22½	—3	Nil
do. 1st Bonds	Nil	Nil	61½	+1	Nil
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	2 5/16	+ 3/16	6 9 10
British Aluminium Ord.	10	10	4	—	11 8 6
British Insulated Ord.	12½	15	13	—	10 18 2
Callenders	25	15	13	—	10 18 2
,, 6½ Pref.	6½	6½	17/6xd	—	7 8 7
Castner-Kellner	20	17	2½xd	—	7 13 9
Crompton Ord.	10	10	16/6	—	12 2 6
Edison-Swan	10	10	10/-	—	—
do. do. 5 per cent. Deb.	5	5	70xd	—	7 2 10
Electric Construction	10	10	16/6	—	11 8 6
Gen. Elec. Pref.	6½	6½	17/6xd	—	7 10 9
do. Ord.	10	10	1 3/8	—	*8 8 5
Henley	25	15	13	—	9 4 8
do. 4½ Pref.	4½	4½	8½	—	7 4 0
India-Rubber	10	10	4	—	—
Mot.-Vickers Pref.	—	8	1½	—	9 9 4
Siemens Ord.	10	10	1 3/16	— 1/16	*9 14 2
Telegraph Con.	20	20	21	—	*5 14 8

* Dividends paid free of Income Tax.

CARBON ELECTRODE ARC WELDING AND CUTTING.

AN outline of welding and cutting by means of the carbon arc was given by Mr. O. H. Eschholz in a recent issue of the *American Machinist*, and the article enumerated several advantageous applications of this type of work.

Carbon or graphite welding is the oldest of the electric arc fusion processes now in use. The original process consisted in drawing an arc between the parent metal and a carbon electrode in such a manner that the thermal energy developed at the metal crater fused the edges of two members together.

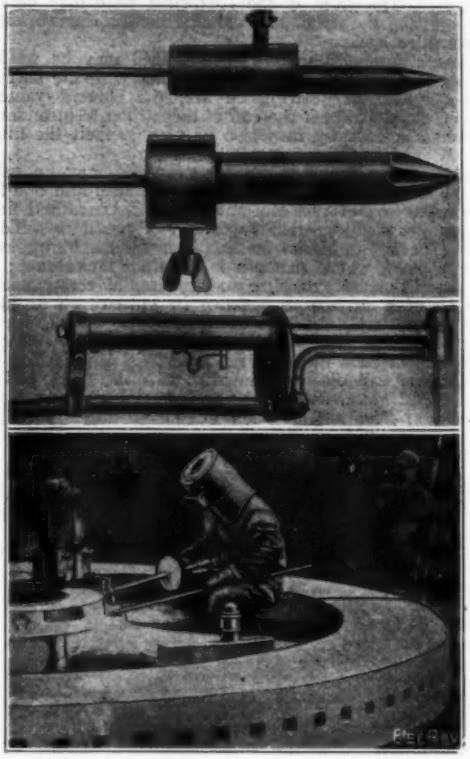


FIG. 1.—ADAPTERS FOR USING CARBONS IN METALLIC ELECTRODE HOLDER.
FIG. 2.—METALLIC ELECTRODE HOLDER.
FIG. 3.—CORRECT WELDING POSITION.

This process was early modified by adding fused filling metal to the molten surface of the parent metal.

The equipment now used consists of a direct-current arc-circuit possessing inherent means for stabilising the carbon arc, a welding hood for the operator, an electrode holder that does not become uncomfortably hot in service and suitable clothing such as bellows-tongued shoes, gauntlets, and apron of heavy material.

When arc currents of less than 200 amp. are used, or when a graphite arc process is employed intermittently with the metallic electrode process, the carbon-holding adapters shown

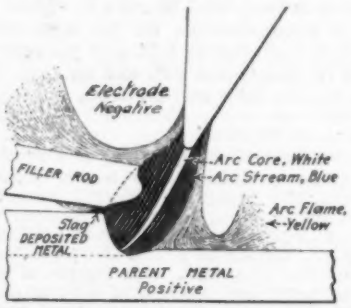


FIG. 4.—POSITION OF ELECTRODE AND CHARACTERISTICS OF THE ARC.

in fig. 1 may be used with the metallic electrode holder, the shank of the adapter being substituted for the metal electrode. With very high arc currents, 750 amp. or more, special holders should be constructed to protect the operator from the intense heat of the arc. Fig. 2 shows a typical holder.

Electrodes.—Although hard carbon was originally employed for the electrode material, experience has shown that a lower rate of electrode consumption as well as a softer weld may be obtained by substituting graphite electrodes. While both electrodes have the same base and binder, the graphite electrode is baked at a sufficiently high temperature (2,000 deg. C.) to graphitise the binder, thereby improving the bond and the homogeneity of the electrode.

The diameter of the electrode is determined partly by the arc current. To fix the position of the carbon arc terminal, thereby increasing arc stability and arc control, all electrodes should be tapered. This precaution is particularly important when using a low value of arc current, or when maintaining an arc under conditions which cause distortion and instability. The following table gives electrode diameters in most common use with various arc currents:—

Amperes	Diameter
50 to 150	¼ in. tapered to ⅛ in.
150 to 300	⅜ in. tapered to ¼ in.
300 to 500	1 in. tapered to ¼ in.
500 to 750	1¼ in. tapered to ¼ in.
750 to 1000	1½ in. tapered to ¼ in.

Filler Material.—A strong, sound weld can be obtained only by using for filler metal low-carbon, commercially pure iron rods having a diameter of ⅜ in. or ¼ in., depending on the welding current used. Cast iron or manganese steel filler rods produce hard welds in which the fusion between the parent and added metals may be incomplete. Short rods of scrap metal, steel turnings, &c., are frequently made use of for filler metal when the purpose of the welder is merely to fill a hole as rapidly as possible. It should be understood that welds made with such metal are weak, contain many blowholes, and are frequently too hard to machine.

For graphite arc welding employing a filler the correct posture of the operator is shown in fig. 3. The filler rod is grasped by the left hand with the thumb uppermost. When held in this position the rod may be used for brushing off slag from the surface of the metal.

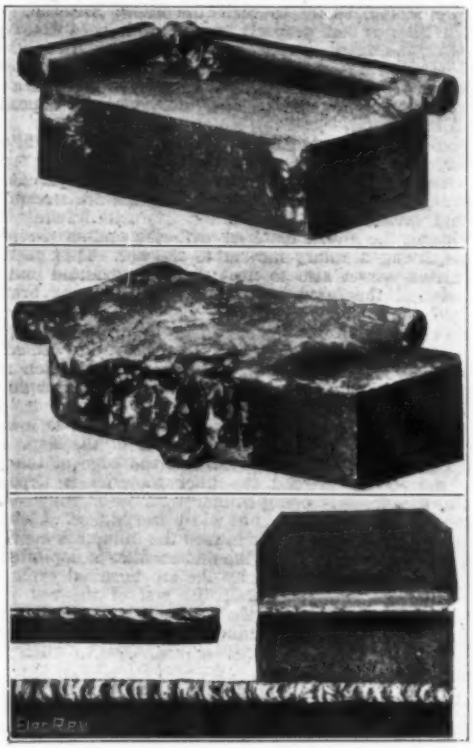


FIG. 5.—BUILDING UP PROCESS—COMMENCEMENT.
FIG. 6.—BUILDING UP PROCESS NEARLY COMPLETED.
FIG. 7.—FLANGED EDGES WELDED WITH GRAPHITE ARC.

The surfaces to be welded should be chipped clean, and where they are scarfed the angle should be wide enough to enable the operator to draw an arc from any point without danger of short-circuiting the arc. The practice of removing sand and slag from the metal surfaces by fusing them with the arc and striking the mass with a hammer should be discouraged on account of the danger of flying fragments.

Arc Manipulation.—If the arc is formed from the surface of the deposited metal or from that of a molten area, slag particles may adhere to the end of the electrode, deflecting the arc, and rendering manipulation difficult. When the electrode is held vertically, irregularities in the direction and force of convection currents deflect the arc, causing movements in the metal arc terminal. By inclining the graphite electrode approximately 15 deg. to the vertical the deflecting force is constant in direction, keeping the arc stream and arc terminal approximately in line, as shown in fig. 4.

Polarity.—The positive terminal of a carbon arc is hotter and consumes more energy than the negative. Consequently, if the electrode is made the positive terminal, energy will be uselessly consumed, and the resulting higher temperature will increase the consumption of the carbon, and moreover a very unstable arc will be obtained. Therefore the electrode should always form the negative terminal, and any reversal of polarity will be detected by the excessive heat developed.

Arc Length.—If carbon is permitted to be absorbed by the fluid metal a hard weld will result, and therefore practically all the volatilised carbon should be oxidised. This may be accomplished by regulating the arc length so that atmospheric oxygen will have ample time to diffuse through the arc stream, and combine with the carbon present. The correct arc length is dependent on the welding current and the degree of confinement of the arc. Since the arc diameter varies as the square root of the current, the arc length should be increased in proportion to the square root of the current. It is also obvious that when an arc is drawn from a flat, open surface the vaporised carbon is more accessible to the atmospheric gases than when it is enclosed by the walls of a blowhole. This means that to secure the same amount of oxidised carbon under both conditions the confined arc should be the longer. Many welders are not familiar with this phenomenon, with the result that metal deposited in holes or corners appears to be inexplicably hard.

The lengths of 250-amp. and 500-amp arcs should not be less than ½ in. and ¾ in. respectively when the arcs are drawn from a flat surface. The maintenance of excessive arc lengths causes the diffusion, through convection currents, of the protecting envelope of carbon dioxide, with the result that the exposed hot metal is rapidly oxidised or "burned."

For most purposes a 250-amp. arc should not exceed a length of 1 in. and a 500-amp. arc should not be longer than 1¼ in.

The energy developed at the metal terminal or arc crater is utilised to melt the parent metal, while that generated in the arc stream serves to melt the filling material. If the molten filler is not properly guided and, as a consequence, overruns the fused parent metal, a poor weld will result. This process necessitates, therefore, a constant observation of the distribution of the fused metals as well as a proper control of the direction of flow and speed of deposition of the filling metal.

There are two methods in use for adding the filler with a minimum overlap. One is called the "puddling" process. It consists in melting a small area of the parent metal, thrusting the end of the filler rod into the arc stream, where a small section is melted or cut off, withdrawing the rod and fusing the added material with the molten parent metal by imparting a rotary motion to the arc. This puddling of the metals serves also to float slag and oxidised material to the edge of the fused area, where they may be brushed or chipped off.

The rapid building up of a surface by this method is shown in fig. 5. The short sections of filler rod were welded to the sides of the casting in order to prevent the molten material from overflowing and to indicate the required height of the addition. The appearance of the nearly completed "fill" is shown in fig. 6. One side of the added metal is lower than the others to facilitate the floating off of the slag, some of which may be observed adhering to the edge of the plate.

In the second method the filler material is deposited in layers, the deposits being similar to those obtained with the metallic electrode process, but wider and higher. This method simply requires the operator to feed the filling rod continuously into the arc stream so that the molten filler is deposited on the area of parent metal fused by the arc terminal while the arc travels across the surface. If the end of the rod is moved forward while resting on the surface of the newly-deposited metal, most of the slag produced by the oxidation of the hot metal is floated to the sides of the deposit, where it may be brushed or chipped off.

To remove slag or improve the appearance of the deposits the surface of the added metal may be remelted by running the arc terminal over it, provided "burning" and hardening of the metal is avoided.

The expedient of hammering or swaging the hot deposited metal is frequently resorted to where a refinement in the structure of the crystal grains is desirable.

Flanged Seam Welding.—Fig. 7 illustrates a useful application of the original carbon-arc process wherein no filler metal is used, the metal arc terminal serving to melt together the flanged edges.

This process is easily performed. To obtain adequate fusion the arc current selected should have such a value that the metal-arc crater nearly spans the edges of the seam. To assure the maintenance of a stable arc a small, tapered electrode should be employed, the diameter of the electrode end remaining less than ½-in. during use.

The graphite arc process is used occasionally to form butt and lap welds by melting together the sides of the joint without the use of filler metal. Examination of sections through joints made in this manner reveals that the weld is very shallow, and therefore weak.

Welding of Non-ferrous Metals.—Copper and bronzes have been successfully welded with the graphite arc when employing a bronze filler rod low in tin and zinc and high in phosphorus, at least 0.25 per cent. The best filler material for the various analyses of parent metals has not been determined, but it is recognised that the presence of some deoxidising agent such as phosphorus is necessary in order to ensure sound welds free from oxide and blowholes. Since copper and its alloys have a high thermal capacity and conductivity, preheating of the structure facilitates the fusion of the joint surfaces. The grain of the completed weld may be refined by subjecting the metal to a suitable mechanical working and temperature cycle.

Low-melting-point metals such as lead may be welded by holding the graphite electrode in contact with the surfaces to be fused without drawing an arc, the current value used being sufficient to heat the end of the carbon to incandescence. The hot electrode tip may also be used to melt the filler rod into the molten parent metal.

Application.—The graphite arc processes may be used for the following purposes: Welding of cast steel and non-ferrous metals; cutting of cast-iron and cast-steel risers and fins and non-ferrous metals; rapid deposition of metal to build up a surface or fill in shrinkage cavities, cracks, blowholes, and sand pockets, where strength is of minor importance; fusion of standing seams; melting and cutting of scrap metal; remelting of a surface to improve its appearance or fit; preheating of a metal structure to facilitate the welding operation, to reduce locked-in stresses or to alter some dimension; deposition of hard metal or the hardening of a surface by the inclusion of vaporised carbon, such as rails, frogs, and wheel treads; and automatic cutting and welding of sheet metal.

Cutting.—The manipulation of the cutting arc is exceedingly simple, the operator merely advancing the arc terminal over the section to be cut at a rate equal to that at which the molten metal flows from the cut. The cutting speed increases with the value of arc current used. The width of the cut increases with the arc diameter, and therefore as the square root of the arc current. When cutting deeper than 4 in. the electrode should not come into contact with the walls of the cut and thereby short-circuit the arc. This process may be used for cutting both ferrous and non-ferrous metals. It is often used for the "burning" out of blast-furnace tap holes and the melting or cutting of iron frozen in these furnaces.

THE HEATING OF BURIED CABLES.

(*Abstract of Report discussed before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

(*Concluded from page* 842.)

SECTION II.

Report, by Mr. E. Fawssett, May, 1920, on Work at Newcastle-upon-Tyne on e.h.p. Paper-insulated Cables laid direct in the Ground at Different Depths.

The depths were 1, 2, and 4 ft. from the ground surface to the top of the 2-in. concrete slab over the cable, corresponding to depths of 1¼, 2¼, and 4¼ ft. approximately to the centre of the cable. The results show considerable variation between tests on the 1 ft. and 2 ft. depths, but a fairly constant difference between those on the 1 ft. and 4 ft. depths. The average increase in temperature-rise for the same current for the cable at 2 ft. over that at 1 ft. is 4 per cent., and for the cable at 4 ft. over that at 1 ft. 15.7 per cent. This amounts to rating the 2 ft. cable at 2 per cent., and the 4 ft. cable at 7.5 per cent. less current than the 1 ft. for the same temperature-rise on the core.

The tests were carried out in fairly still weather and under average winter conditions. The results obtained with D.C. did not show any perceptible difference from those obtained with A.C. The whole of the results obtained are plotted in fig. 7, in which actual temperature rises are shown as against depth, and at the top is plotted the percentage increase in temperature rise with depth, over the rise of the 1 ft. cable. This shows clearly how the ratio of the rise of the 1 ft. and 2 ft. cables varies with the different tests, and it should be emphasised that this variation is not due to inaccuracy in the measurements. The average curve probably represents very fairly the average results to be expected from an armoured cable laid direct in the ground under average conditions in winter weather in a soil of average moisture content.

Various samples of the soil were taken at different times while the tests were in progress, and the moisture content was determined. This was never far from 20 per cent.

SECTION III.

Report, by Prof. E. W. Marchant, on Work at Liverpool University on Vulcanised Bitumen Cables laid solid in Stoneware Troughing.

Four pairs of feeders were laid at a depth of 3 ft. below ground. The cable was insulated by two layers of fibre served on the conductor, then dielectric of vulcanised bitumen, then two layers of strong bitumen tape well compounded, and was supported on porcelain bridges in stoneware troughs, filled with bitumen, and covered with flat tiles, the arrangements being the same as those employed by the Corporation in ordinary street work. The ground in which the cables were laid was a soft sandstone rock in which the moisture was usually found to be about 10 per cent.

It was suggested that the temperature coefficient of the copper in the cables might be measured by observing the

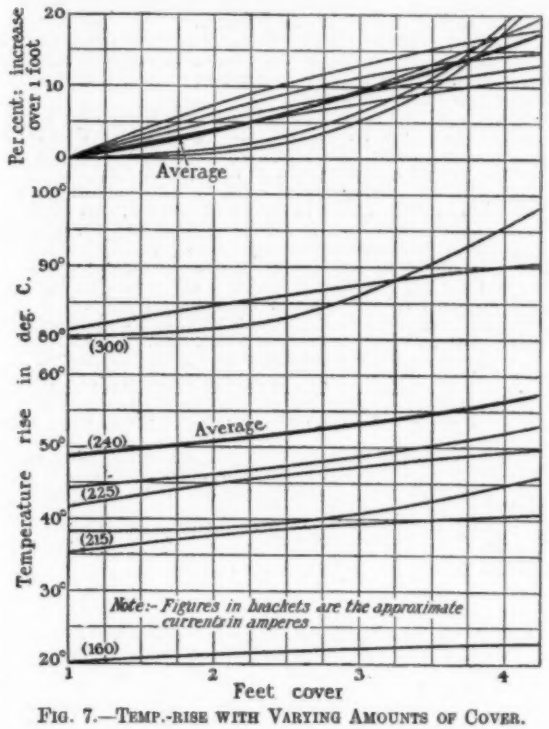


FIG. 7.—TEMP.-RISE WITH VARYING AMOUNTS OF COVER.

resistance of the cable at the ground temperature, for different ground temperatures. The results obtained, however, fig. 6 (see p. 842 of our last issue), did not give any definite relations between those quantities. The ground temperature, as read on a thermometer, varied. In other cases the ground temperatures were steady while the cable resistance varied. Again variation in ground temperature occurs daily, and when a test was being made this variation had apparently no effect upon the cable resistance.

The mean ground temperatures at the depth of the cable (3 ft.) have been taken continuously and seem nearly constant at about 5 deg. C. throughout the winter, until the middle of April. Then it rises steadily till at about the middle of June it assumes a nearly constant value of about 14 deg. C.

Measurements were made of the temperature coefficient of the copper, and the results show that the mean temperature coefficient was about 0.409 per cent. from 10 deg. C., which agrees with the value given by the British Engineering Standards Association for that temperature. The temperature rise of the cable was estimated from the increase in its resistance. The sandstone in the trench never contained less than 8 per cent. of moisture. During the time that these tests were run, *i.e.*, June, 1916, to March, 1917, the maximum amount of moisture was 13 per cent., the soil in this condition being non-friable.

The results of the first series of tests are shown in fig. 8; the temperature rise on any cable is almost exactly proportional to the power loss in it, and the difference in the moisture of the ground surrounding the trough appears to exercise little influence on the heating of the cable. The final rises in each case, namely, at 750, 1,000, and 1,250 amps. per sq. in., are substantially the same, *i.e.*, 10, 20, and 30 deg. C. The tests show that, within certain limits the temperature rise for any given size of cable can be estimated very closely from the rate of heat production in it, and also afford data enabling the effect of momentary overloads to be calculated.

For practical purposes correction for "end effect" may be neglected. The relation between the temperature rise of cables after a six-hours' run and the current passing through them is discussed, and it is shown that the temperature rise is nearly proportional to the square of the current, but it is relatively small with cables of smaller section with given current densities.

The most important factor in the cooling of cables laid directly in the ground is the moisture in the earth surrounding them. The extreme variations in moisture were from nearly 13 to 9 per cent. during a comparatively dry spell. The character of the troughing and its comparatively large heat capacity would lead one to anticipate that the effect of variations in moisture would not be very large except for long continued runs.

After the first series of tests, the 0.6 sq. in. cable was run for 58 hours at 600 amperes. The increase in temperature rise at the end of this period, as compared with that after six hours, is nearly 20 per cent. A further series of tests was undertaken with a view to finding the ultimate rise in temperature after several days' run.

The results have been worked out to show the ratio of the temperature rises after a total time of 12, 24, 48, 72, and 96 hours, to the temperature rise after a six hours' run, and the temperature rise is very nearly the same after 96 hours as it is after 48 hours, *i.e.*, the temperature of the cable reaches a nearly constant value after about 48 hours. The cable approaches its final temperature rise more quickly when it is of small section, than when it is of larger section. The increase in temperaure rise between six and 96 hours is, for the 0.6 sq. in. cable, about 25 per cent. of that obtained on the 6-hour rise, for the 0.4 sq. in. cable about 21 per cent., for the 0.25 sq. in. cable about 20 per cent., and for the 0.1 sq. in. cable about 19 per cent.

So long as the temperature rise did not exceed 30 deg. C. the final rise was very nearly proportional to the watt loss per foot run in the cable, but when the temperature rise exceeded 30 deg. C. there was a slightly greater rise.

Finally, the theory and determination of thermal constants for insulating material are discussed. Values of thermal resistivity for cables of 0.6 sq. in. section are recorded as 487, 540, and 488; and for cables of 0.1 sq. in. section as 507, 530, 536, and 531. The corresponding thermal resistances are given respectively as 43.3, 48, 43.5; and 73.9, 77.1, and 77. The thermal resistance in the same units for the trough filling and ground is given as 87 for the 0.6 sq. in., and 92 for the 0.1 sq. in. cables. The cable covering showed no serious sign of softening, except in the case where the final temperature was 67 deg. C., and the working limit of temperature was estimated to be about 50 deg. C., which is of the same order as the figure of 43 deg. C. usually employed in specifications for this type of cable.

Four factors affect the heating of cables, namely, the thermal conductivity of (*a*) the cable covering, (*b*) the bitumen in the trough, (*c*) the trough itself, and (*d*) the surrounding earth. The earth immediately above a trough carrying cables, in which the temperature rise was about 20 deg. C., was not more than 5 or 6 deg. C. above that of the normal earth temperature. The fact that there was little difference in cooling with varying degrees of moisture is, therefore, not surprising. An empirical relation is suggested for determining the heating of these cables. The equation connecting current and temperature rise at any given final cable temperature may be expressed as:—

$$I = K \sqrt{T A / R (1 + a t)},$$

where I = current passing, R = specific resistance of copper at 0 deg. C. in ohms per sq. in., $a = 0.00427$, the temperature coefficient of increase of resistance at 0 deg. C., A = cross

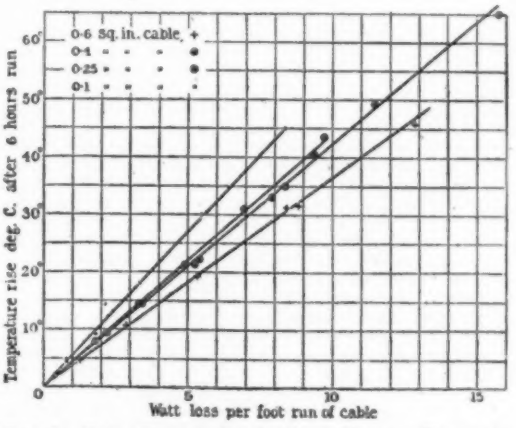


FIG. 8.—TEMP. RISE OF CABLES LAID SOLID IN BITUMEN IN STONEWARE TROUGHS.

section of cable in sq. in., T = excess temperature of cable above surrounding earth, t = ground temperature plus T in deg. C., and K = constant depending on the cable covering and the trough and surrounding earth. The values of K are respectively 148, 142, 136, 124 microhms for the 0.6, 0.4, 0.25, and 0.1 sq. in. cables tested after a six-hours' run.

DISCUSSION IN LONDON.

Mr. E. B. WEDMORE, director of research, introduced the report, briefly referring to the circumstances which led to the inauguration of the research, and pointing out that the report was only a preliminary one; much important work had been done since it was printed, and more remained to be done, the report, therefore, should not be assumed to be a complete one. Any suggestions put forward in connection with the work still to be carried out would be welcomed and carefully considered by the committee in charge of the research work.

Mr. S. W. MELSOM and Miss V. COCKBURN, of the N.P.L. at Teddington, Mr. E. FAWSSETT, of Newcastle, and Prof. E. W. MARCHANT, of Liverpool University, were present to reply to the various points raised in the course of the discussion. The meeting was scantily attended, and the discussion was on the whole disappointing.

Mr. C. P. SPARKS opened the discussion by explaining that Mr. Melsom had taken the tables issued in the I.E.E. Wiring Rules as a basis, and the outcome was the present report. The huge standing charges involved in distribution systems were of the first importance, and it was only by knowing what the safety factor really was that they were working with, and the limiting temperature the material would stand, that they could hope to make the best use of the colossal investment contemplated in future schemes, which would grow. In the past they had little knowledge of the real safety factor, but now knew that they could work at higher temperatures. With regard to the comparison of the different ways of laying cable, further investigations with grouped cables would show a still greater discrepancy against the "solid" systems. Fig. 2 showed a difference of 7 deg. C. between solid and armoured cables, which did not agree with Mr. Melsom's statement that thermal resistivity was not so important as might appear at first sight. Concerning the rating of cables depending on the depth at which they were buried, a definite distance from the surface would appear to be necessary to avoid mechanical damage. The correct method of tackling the problem of temperature rise was that of the watt loss per ft. run of cable, especially where cables were grouped close together. The final permissible maximum temperature of a paper-insulated cable was fixed in the I.E.E. Wiring Rules as 150 deg. F.; the figure did not refer to large or buried cables, but was a safe one for ordinary conductors used in houses, and he hoped to see that figure increased before long.

Mr. C. J. BEAVER thought that Mr. Melsom's remarks on the actual amount of moisture present in the soil seemed to have been written with some surprise. The reason for that surprise was, in the speaker's opinion, to be found in the incorrect information given in Table II. It was difficult to believe that the current-carrying capacity of cables laid "solid" and direct in the ground did not differ considerably. In his opinion it would be dangerous to increase the figure of 150 deg. F. referred to by Mr. Sparks, because although paper and other organic matter deteriorated up to a certain point slowly under the influence of heat, once that point was reached further deterioration was very rapid. Dielectric heating problems were of the first importance.

Mr. B. WELBOURN explained that having been connected with the committee in charge of the research for some three years, he was not in a position to criticise its work, but he paid tribute to the investigators, and pointed out that as the work had been carried out during the war period difficulties had been experienced in obtaining samples and money. Referring to the superiority of armoured cable laid direct in the ground, he did not think much attention need be paid to the current-carrying capacity of the solid system, because, if it was not already dead, it was distinctly moribund. Armoured cable laid direct in the earth would carry probably 25 per cent. more current than a corresponding cable drawn into a duct, which fact was not commonly appreciated. Unfortunately it was not possible to take advantage of it in the case of many town networks, because high excavation costs necessitated the adoption of a duct system. The normal was that for equal current-carrying capacity more copper was needed in a duct system. The suggestion of varying the size of the conductor according to the nature of the ground through which it was laid deserved consideration, but would it be worth while doing so in practice? Mr. Melsom's table of cables corrected to two standard values of thermal resistivity would, he thought, profoundly influence cable manufacture both at home and abroad. Probably 2 ft. 6 in. would be the best depth at which cables should be laid. Bitumen cables were used in collieries in high temperatures, and Dr. Marchant's figures for the continuous working temperature of such cables were interesting as showing that the permissible safe rise to be allowed must inevitably reduce the current-carrying capacity of the cable.

Mr. P. ROSLING was of the opinion that the thermal resistivity of the soil under various conditions was of even more importance than dielectric heating; it would have a larger reflex on the current-carrying capacity. The temperature of a cable was generally taken as that of the lead sheath, but it was the temperature of the conductor that mattered. It should be clearly defined which of the two temperatures was referred to, but the I.E.E. Rules omitted to do so.

Mr. R. O. KAPP remarked that the theoretical law for temperature rise plotted against time was generally assumed to be an exponential curve, and suggested that the research workers should try and ascertain why most of the heating curves given in the report approximated closely to such a curve while others varied by about 10 per cent. If the reason could be ascertained they would probably be able to formulate some law relating to the over-loading of cables. Concerning the heating of cables, the earth effect was equivalent to a larger cable, the earth took part in storing as well as in dissipating heat.

Mr. T. N. RILEY wanted a summary of the work so far done, showing how it could be put to practical use; as given in the report the results only applied to cables laid in a particular manner. He asked for an indication of the relation, as regarded heating, between a cable laid along the ground and one coiled as usually tested in the works. Tests had been made in America which showed that filling the ducts with petroleum jelly reduced the temperature by 14 per cent. for the same current-carrying capacity.

Mr. J. R. BEARD pointed out the danger of assuming that cables should be run up to the maximum limits indicated in the report. The impression that cables when laid deeper were cooler was wrong.

Mr. H. M. SAYERS suggested that expansion effects upon loaded cables should be investigated, particularly with regard to plumbed joints; apparently repeated expansion and contraction caused cables to rack at such joints.

Mr. G. L. ADDENBROOKE referred to tests he had made 16 years ago of some cables in service in London, and suggested that as he still had the records and apparatus, and the cables also still existed, it might be worth while repeating the tests so as to provide actual data on deterioration.

From the reply to the discussion it appeared that the "reporters" had at the moment no more information to give than was contained in the report itself, and that suggestions made at the various discussions would prove useful to them. The heating curves did not follow an exponential law; if they had done so it would not have been necessary to carry out much of the work that had been done, and the suggestion of filling the ducts with vaseline was too costly to be entertained.

Prof. MARCHANT pointed out that the report had shown how the universities and technical colleges could be associated with the N.P.L. in technical research work with beneficial results to all concerned. In his opinion the equation which had been derived connecting the current and temperature rise at any given final cable temperature was the most important part of his section of the report.

DISCUSSION AT NEWCASTLE-ON-TYNE.

AT Newcastle-on-Tyne the report was discussed before the North-Eastern Centre of the Institution on December 13th. Mr. J. R. BEARD presided, and Mr. VERNIER briefly outlined the origin of the committee. Mr. S. W. MELSOM, of the National Physical Laboratory, and Mr. E. FAWSSETT, Newcastle, submitted the salient features of the report.

Dr. W. M. THORNTON in opening the discussion, said that the resistivity measurements showed clearly a total variation of 4.7 per cent. (101.2 to 96.5). Was that considered satisfactory in the light of the British Standards requirements? The value of the temperature coefficient given by the N.P.L. was 0.00390 at 20 deg. C., but Dr. Marchant's value was 0.00393 at the same temperature, the difference being 7.7 in 1,000. These measurements were made with double bridges at Teddington, Liverpool, and Newcastle, and in view of the fact that an accuracy of 1 in 1,000 was readily obtainable by double-bridge working, he asked whether the bridges had been compared at the N.P.L.—as all instruments in a joint research of that kind should be. The work on the influence of the state of the surface of cables in air gave interesting results. Cables with aluminium painted surfaces ran 22 per cent. hotter than when the surface was dull. As might be expected, at low temperatures the colour made no difference so long as there was no bright metallic surface exposed. But if the heat were lost by low-temperature radiation alone, he would expect a much greater difference between bright and dull surfaces. His own observations on the heat lost by roofing confirming other N.P.L. results would lead one to think that there would be five or six times more lost when dull than when bright. That that was not so pointed to the fact that the greater part of the heat was lost by conduction and convection when the cables were in air, and a comparatively small amount by radiation. The relation between temperature and current, as given in the reports (figs. 6, 7, 8, and 11), was approximately a square law, but the index rose. In fig. 8 writing $\theta = a\,i^n$, $n = 2$ at 110 amperes, 2.16 at 140, and 2.25 at 165, and showed signs of still higher figures. Now, if the temperature rose faster than the heat generated it seemed that the rate at which heat was got rid of fell as the temperature rose; that the cooling was proportional to some law with an index less than unity. The temperature gradient in fig. 9 was uniform from the inner conductor to the outside of the sheath, and the triangular curve would fit even better if instead of being drawn to a point the curve's ends were set at the diameter of the inner conductor apart. The conclusion from the curve was

that the copper or lead in the cable had no perceptible influence on the gradient, or that the drop of temperature in the metals was negligible. The curves of rates of rise of temperature, figs. 1 to 5, were approximately logarithmic, but appeared to be complicated by variations of the loss coefficient. They should be logarithmic, and any departure from that form could only be attributed to variation of the coefficient of dissipation to earth. For, considering the equation of heating and absorption, in heat units it was:—

$$\sigma \nabla^2 \theta / J = W / J = m \sigma d\theta / dt + k s (\theta - \theta_0),$$

where m was the mass of unit length, s its outer surface, σ the specific heat, and k the coefficient of cooling to the ground. Where there was cooling to air there was radiation to be considered, perhaps to be included in the linear cooling law, and convection which followed the same law at low temperatures. The rate of transfer of heat was relatively rapid through the insulation, its thickness was small, and there was no need for the introduction of a term covering the thermal conductivity of the dielectric if the temperature θ were taken at the surface. The solution of the above equation was:—

$$\theta = \theta_0 + \theta_1 (1 - e^{-k s / m \sigma t}),$$

the final running temperature being $\theta_0 + \theta_1$. If the curve of rise was not simply logarithmic it could then only be by variation of the ratio $m \sigma / k s$, that was of σ or k. It was unlikely that the specific heat would change, and the curves, therefore, provided a means of observing the changes in the value of k from time to time, that involving the conductivity of the surrounding earth as a factor in the rate of cooling, but all included in the numerical value of k. The thermal time-constant of such a rise was $m \sigma / k s$, which could be obtained in the usual way by drawing a tangent to the curve at zero and dropping a perpendicular to the time line from the point where it cut the steady value. Fig. 5 contained final steady values drawn to a base of copper area × outer diameter of sheath, but it might be simpler to plot θ_1 against diameter alone. It was always difficult to estimate with any degree of certainty when the steady state was reached, but by taking $\theta = .95\ \theta_1$, or any other suitable ratio approaching unity, they could find the corresponding time t' from the curves or by calculation to a much closer degree of approximation. Having chosen some such value to be used in all cases, the log term was constant; t', therefore, varied as $m \sigma / k s$. But for any one given type of cable it varied as the total sectional area, and s as its diameter, so that as a first approximation, t' varied as the diameter σ. The ordinates of fig. 5 might then plot to a straight line if the abscissæ were taken as overall diameter. If the time of reaching a steady state were approximately proportional to the diameter of the cable it would simplify matters, but there would always be the difference of soil or other conditions to be considered as varying k. The observed time constants of the given cables suggested that the cables might fit into a scheme of time constants in a fairly regular manner.

However interesting this preliminary report might be in the problems it dealt with, not the least interesting of which was the thermal resistivity of cable material so fully discussed later in the paper, and in the valuable results of the work at Liverpool, it all led up to *deterioration*. Was there enough evidence of the effect of continued temperature and electric stress, direct or alternating, on the life of insulating materials? They could make a paper cable last as long as they pleased by enclosing it in lead. V.I.R. cables, with a vegetable gum as a basis must deteriorate with time. Paper was more durable, and he saw no reason why paper cables should not last 5,000 years if lightly loaded in the same manner as the papyrus of ancient Egypt. The supply companies' problem was to find the most economical current to run a cable at, having regard to its earning power, life, and cost of renewal.

Mr. BERTRAM said one of the most interesting parts of the report was the conclusion arrived at by the committee concerning the end of armoured cables with regard to the rise of temperature. The figures given, showing a rise of more than 33¼ per cent., would surprise many of their operating engineers.

Mr. PARKER wanted more information with regard to the temperature at which it was safe to run a cable for an overload purpose, say, for one or two hours. Operating engineers would like some instrument which would assist them in this matter.

Mr. ALLEN suggested that the results obtained might be sent out to their members in, say, Australia and South Africa, with a view of obtaining detailed information about the conditions met with elsewhere, particularly in hotter climates so as to assist in making the records complete.

Mr. H. BRIDGES said the paper dealt largely with single cables, but they needed to go further than that, and they looked forward to the results of the committee's work with groups of cables. In the future they would have to pay more attention to the amount of ground they should give to cables at stations. Cable makers were turning out cables with thinner dielectrics than in years gone by; were they running any risks in reducing the thickness of the dielectrics? Cable depreciation was the real question.

Mr. E. B. WEDMORE spoke of the need for research work, and the effort the committee was making to make the work of real utility.

REVIEWS.

Lectures on Industrial Administration, delivered at Cambridge, July, 1919. Edited by B. MUSCIO, M.A. Pp. viii+276+16. London: Sir Isaac Pitman & Sons, Ltd. Price 6s. net.

Industrial Administration; a series of Lectures. Pp. viii+203. Manchester: The University Press; and London, New York, Bombay, &c.: Longmans, Green & Co. Price 7s. 6d. net.

The first of these two books consists of twelve lectures, delivered at Cambridge in July, 1919, at which time there was held there, under the general direction of Dr. C. S. Myers, F.R.S., a school for the study of certain industrial management problems, chiefly from the psychological point of view. The volume contains a selection of the lectures delivered at the school, and for some reason, not immediately apparent, it is divided into five parts. The first part contains only one lecture, and it is entitled "Some Ethical Aspects of Industry," the lecturer being Prof. W. R. Sorley, Litt.D., LL.D., F.B.A.

Criticism is to some extent deprecated (we will not say disarmed, for criticism disarmed is criticism neglecting its plain duty) by the lecturer's opening remarks, in which he states that his contribution must have the appearance of a series of platitudes. Nevertheless, platitudes ought to be repeated now and then, if only to see that we remember them properly, and we are none the worse off for being reminded that there *is* an ethical side to industry, though it is in these days more often ignored, if remembered, by both sides, than acted upon. It would do everyone good to think a little more about duty. Labour is fond of saying it is the employer's duty to provide good conditions and a good wage for workers, and employers point out the duty of the workers to do as much as they are able. Both are right, but each should lay emphasis on its own, and not the other side's, duty.

The second part contains three lectures. They are: "The Need for a Science of Industrial Administration," by Mr. J. A. Bowie, M.A.; "Some Tendencies in Industry," by Mr. E. M. Wrong, M.A.; and "Taylor's Principles in Modern British Management," by Mr. A. R. Stelling. Of these three, Mr. Bowie is concerned with proving the necessity for something that everyone agrees to be necessary, so he is banging at an open door. It is probably because he feels this to be the case that he exaggerates the failings of the old-time director or proprietor of a business, who is said to stamp even his idiosyncrasies on the business he controls, to such an extent that British industry is a "riot of individuality," the while "many employers are not fit to be decent labourers." The quotation marks are Mr. Bowie's, but he is in agreement with the sentiments expressed. He also states it as his opinion that "it is certain that the usual commercial courses now being promoted in many of our universities aim at imparting the principles of pure industry, rather than applied or administrative." Now, industry is an applied science, or it is nothing, and how any distinction can be made between pure and applied industry we cannot understand. Mr. E. M. Wrong's contribution bears evidence of that careful thought we are accustomed to find in his writings, and he shrewdly hits one of two nails on the head, as when he remarks: "When in doubt Englishmen form a committee, whether they are in Parliament or in a factory"; and summarises the objections to Government interference as coming mainly under three heads: Complaints against the Liquor Control Board, objection to any limitation of profits, and fear of inefficiency. We may note their relative positions. He also points out a feature of time-registering systems to which those who use them have grown so accustomed that they think of them as a normal and inseparable adjunct to the systems, viz., that insistence on "clocking off" causes a queue to assemble in front of the clock in order to be in a position to begin clocking the moment the buzzer blows. The value of the time lost through this practice is seldom appreciated. The fourth lecture, by Mr. A. Robert Stelling, deals with Taylor's principles and some of the objections to their adoption. The workman does not want to be forced to carry out a manufacturing process in accordance with a specification detailing every motion and the time to be occupied in doing it. And he is not going to agree to anything of the kind if the inevitable result of the increased output brought about is a reduction in the piece rate, and while he realises that his earnings will be limited in some way or other. The Taylor system, as understood—or possibly misunderstood—in this country, is too impersonal, too inhuman, to be received with any enthusiasm. If they were properly understood and applied, as Mr. Stelling shows they could be and ought to be, Taylor's principles are not only practicable for British industry, but afford a complete solution of the problem of the increase of production.

The fifth lecture, with which the third part begins, is on "Vocational Diagnosis in Industry and at School," by Mr. Cyril Burt, and is largely a piece of special pleading on behalf of the science of psychology. We are not prepared to accept a number of his conclusions without something very much more adequate in the nature of proof than he has seen fit to give in the lecture. "A child who at six has a mental age of three, and therefore a mental ratio of only .50 per cent., will at the age of sixteen exhibit, as a rule, the same mental ratio, and therefore attain a mental age of only 8." Taking

due account of the qualifying "as a rule," we wonder if this is a correct deduction. The six-year-old child with the mental age of three may be merely a late starter, and at sixteen he may very well have attained a mental age of thirteen. It does not necessarily follow that the law is of the same character as a geometrical progression; it may conceivably be arithmetical. His process of sifting children, so that only the "duds" are left for trade vocations, would not appear to us to be the best thing for industry. The value of competitive examinations as a means of selecting the best from among a number has, we think rightly, been much questioned of late years, and in spite of Mr. Burt's advocacy of it in the case of the children who are to be sorted, it must not be assumed that the man who only succeeds in matriculating in the second division will not go far.

The sixth lecture, by Mr. S. Wyatt, M.Sc., M.Ed., on "The Psychology of Advertising," contains little that is new. The seventh, on "Social Psychology and the Industrial System," is by Prof. T. H. Pear, M.A., who occupies the chair of psychology in the University of Manchester. This lecture is exceedingly interesting, but affords small scope for criticism.

Part IV opens with the eighth lecture, that on "Industrial Overstrain and Unrest," by Dr. Charles S. Myers, M.A., M.D., Sc.D., F.R.S., the director of the course. The damage done by fatigue is nearly always under-estimated, and although the cynic may be tempted to wonder how fatigue or overstrain is possible in these days of ca' canny, short hours, no overtime, and similar agitations, there is no doubt that it is wrong to work the system to the point of fatigue, no matter what the occupation. Dr. Winifred Cullis, D.Sc., follows with a lecture on "The Demands of Industry upon Women from the Physiological Standpoint." Our opinion is that she unduly minimises the effects of the differences in structure and in function between men and women upon their suitability—not their capacity—for industrial work, and there are other medical women who are of an entirely different opinion from Dr. Cullis on this important point. It was a fine thing to see, during the war, strong hefty girls pick up a chunk of lead and slog the chuck holding a big shell to tighten or loosen the screw, but in the interests of women themselves, and of the race, they should not be employed on heavy work while there is any doubt—and there is much—as to the effects produced on the organism. Another medical lecture follows, on "The Practice of Industrial Welfare and Health," by Dr. Edgar L. Collis, M.D., who has occupied the important position of Director of Welfare and Health under the Ministry of Munitions. We think he is wrong in crediting primitive man with a knowledge of the fact that the primary reason for the existence of industry is the service of the community, and in stating that this primitive purpose became more and more overlaid as time went on. It has been learned at long last after many trials and errors; the community was not considered of any importance in the earlier stages of human history. Individualism was rampant through feudal times, and through the earlier periods of the industrial era which, broadly speaking, began in the century before last. A mistake on p. 205 credits the Welfare Department with murderous intent, alleging that it (the Welfare Department) should deal with reasons why the *lives* of the workers should be so long, instead of their *hours*. For the rest, while he advocates the establishment of a welfare and health department in all undertakings, he dabbles, tinkers half-heartedly, and talks down, and we are not at all inspired by his recommendations. Either welfare work is worth doing properly, or it is better left alone. No good at all can be done by going into it with any idea of tenderness towards prejudice and ignorant pigheadedness; the welfare administrator should be of sufficiently high standing to see his ideas carried out to their full extent.

The fifth part opens with the eleventh lecture, which is by Mr. A. P. M. Fleming, C.B.E., M.Sc.Tech., M.I.E.E., on "Industrial Research." His synopsis of American practice is both interesting and useful, and cannot be too widely known. We believe research to be entirely worth while, and it is well that it has been realised by the great ones of the industrial world that it must be undertaken wholeheartedly and earnestly, with determination and will to overcome discouragements. We do not agree that routine testing should be done by the research department. The last lecture is by Dr. P. Sargent Florence, M.A., Ph.D., on "The Statistical Measurement of the Human Factor in Industry." It is chiefly of interest as showing the extent to which absorption in a science can carry one into the realms of impracticability. Does Dr. Florence really expect to get truthful answers to personal questions about people's homes, recreations, use of earnings, tastes, and so forth? No doubt such statistics would have a certain value if they could all be tabulated and Hollerithed, but the fact is they cannot, and we must be content to accept that fact. Industrial management will have to stay in the works, and the improvement of homes and habits is a matter for the schools and for voluntary self-education.

The second book contains a set of eight lectures, delivered at Manchester, and they cover much the same ground. Prof. Pear, indeed, lectured both at Cambridge and at Manchester. The first lecture is by Mr. B. Seebohm Rowntree, on "Social Obligations of Industry to Labour." He analyses carefully the expense of running a working man's home, and emphasises the necessity for raising the pre-war standard of living. We think there is danger in the suggestion that employers should give workers a guarantee that no man shall suffer through the introduction of labour-saving machinery. The endeavour should be to increase output and demand, so that the introduction of improvements will actually lead to more employment and better amenities of life for everybody. And if each industry carries its own unemployment, as may very possibly be the case before long, one of the objections to the use of labour-saving devices will disappear from the mind of labour. Prof. Pear's lecture is the second, and deals with "The Applications of Psychology to Industry." He emphasises the value of observation, and shows that two types exist, the "spread" and the "concentrated." We suppose everyone who has read of Sherlock Holmes realises the usefulness of observation of both kinds, but its value is immensely enhanced if it can be made automatic. It is the chief value of the Pelman, and indeed, of any system of mental training that it conduces to the attainment of speed and expertness in this respect. Mr. A. E. Berriman, O.B.E., M.I.Mech.E., lectures on "Education as a Function of Management," and he deals in considerable detail with apprentice training. Dr. T. M. Legge, C.B.E., M.D., D.P.H., comes next with a lecture on "Occupational Diseases." Mr. Leonard Hill, F.R.S., lectures on "Atmospheric Conditions and Efficiency," and in spite of immense improvement in this matter of late, or at least during the last thirty years or so, he shows conclusively that there is still more to be done than has yet been accomplished. The expectation of life in a big city is sixteen years less than it is in the healthiest districts. The importance of smoke abatement and of the movement towards small garden cities could not be better illustrated than by that statement.

Mr. T. B. Johnston, J.P., lectures on "Industrial Councils and their Possibilities," and his contribution gives an account of valuable work that has been done in the pottery trade. Mr. St. George Heath lectures on "Training for Factory Administration," explaining the nature and objects of the education required. The eighth and last lecture is by Dr. A. F. Stanley Kent, M.A., D.Sc., on "Industrial Fatigue," and is ratehr elementary.

It is a good sign that such courses of lectures should have been provided, and that they should have been successful. They will be of use to a wider audience through being reprinted, and we hope other similar courses will be arranged. The success of industry, particularly in Great Britain, depends on the human factor more than on any other, and for this reason the science of psychology and its applications to the betterment of the industrial situation are worthy of close and constant study by all who are concerned in any way with the directing or administering of industry.

The Elements of Electrotechnics. By A. P. YOUNG, M.I.E.E. Pp. 348+viii; 179 figs. London: Sir I. Pitman & Sons, Ltd. Price 7s. 6d. net.

The essential object of this book is to explain to students, and others interested in the applications of electricity, the fundamental laws upon which the science is based, and to show how these laws are applied in practice.

This is excellently done; the language employed is simple and lucid, and numerical calculations are given where possible, so that the student shall gain definite ideas of the quantities with which he is dealing.

The novel feature of the book is the way in which the author has illustrated the divisions of his subject by examples from the most recent practice in electrical engineering. As instances, it may be mentioned that, in the chapter on the production of electricity from magnetism, reproductions are given which show sectional views of British magnetos which were developed for use on aircraft engines during the war, whilst in the chapter on electric motors, particulars and performance curves are included of the 1,500-volt series motors used on the Chicago, Milwaukee, and St. Paul Railway.

It might, of course, be argued that these examples are somewhat above the heads of the persons for whom the book is primarily intended, but the method is that of the lecturer who retains the interest of his class by showing them slides of actual machines which embody the principles that he wishes to instil, and, in fact, the work is the outcome of a series of lectures delivered by the author to evening students in a large works.

The notes on permanent magnets and magneto ignition are particularly interesting, and the information given on insulating materials is much more practical and complete than is usual in a book of this type, whilst in the chapter on systems of units this difficult but highly important part of the subject is dealt with in a very clear and convincing manner.

The general scheme is similar to that laid down by the City and Guilds Institute. Alternating currents are not dealt with except for a brief reference in connection with hysteresis and eddy current losses in iron.

The book is illustrated by a large number of diagrams and photographs which are reproduced in an excellent manner, and should prove of great assistance to the student and to the large and increasing number of engineers who, without being actually engaged in the electrical industry, find it necessary to understand something of a subject with which they are continually coming into contact. Furthermore, there is a considerable amount of information which should prove useful to electrical engineers with wider experience than those for whom the book is written.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Unit-type Distribution Pillars.

Standardisation is an essential feature of economic and satisfactory production and working. This especially applies to electrical gear where circumstances usually render it necessary to effect alterations or additions in a minimum of time. The unit-type distribution pillar made by W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., Blomfield Street, London Wall, E.C. 2, is an example of standardisation and simplicity in construction. The frame of the unit consists of two micanite-covered steel tubes coupled rigidly together at top and bottom. Upon this frame are clamped the copper fittings carrying the busbars and fuse clips. The front half of the sealing chamber is bolted on to the frame, and when jointing up it is therefore necessary only to bring up the cables to the bent copper connectors which pass through insulating bushes in the sealing chamber. This method of connecting up the cables to the bars eliminates the use of rubber tails

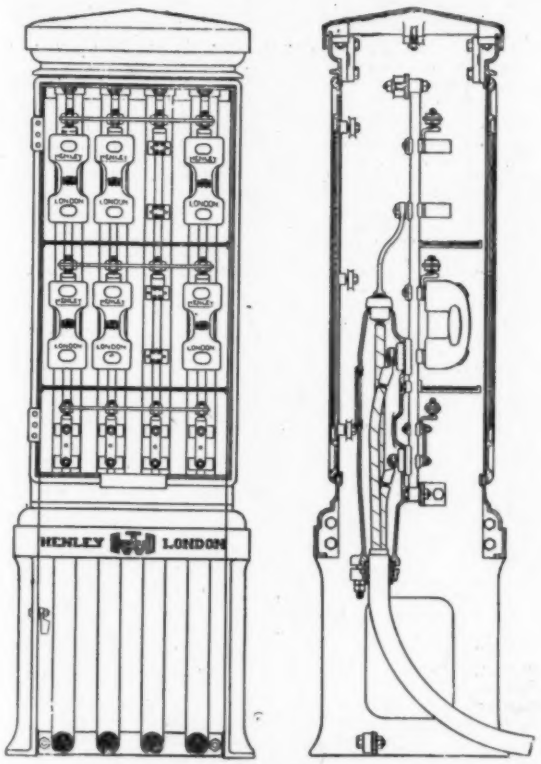


FIG. 1.—THE "HENLEY" UNIT TYPE PILLAR.

and the consequent extra number of joints, reducing the risk of failures to a minimum. It occasionally happens, however, that existing cables are of insufficient length to bring up to the connectors, and in such cases a special sealing chamber can be employed, and rubber tails used to bridge the distance between cables and connectors; this does not affect the rest of the design of the unit. The units are easily interchangeable, and it is only necessary to cut off the supply for a few minutes while changes are being effected. The sealing chambers are supplied with the well-known "Henley" lead cone grips or brass wiping glands, which are designed to deal with all classes of cables with only slight alterations. The units may be bolted side by side on a frame to form a fuse panel, rubber tails being taken to each contact without the use of the sealing chamber.

Fig. 1 shows two views of a pillar containing four units arranged for 3-phase, 4-wire distributors. In this example three of the cores are directly connected to the fuses.

A Cold-starting Oil Engine.

MESSRS. RUSTON & HORNSBY, LTD., of Lincoln, send us particulars of tests carried out by Capt. H. Riall Sankey, C.B., &c., on one of their cold-starting oil engines. The subject of the tests was a 260 B.H.P. horizontal engine, diameter of cylinders (two) 18½ in., stroke 30 in. The load was applied by means of a Heenan & Froude hydraulic brake. The engine was started at 8 o'clock and ran at about half-load for 1½ hours, when full load was applied for three hours. The load was then quickly reduced to ¼, and maintained at this for an hour, after which it was reduced in succession to ½ and ¾ each for an hour. Then for half-an-hour the engine ran unloaded, and during the next half-an-hour was overloaded by 10 per cent. Lastly the ¼-load test was repeated for half-an-hour, and the test then ended. The lower calorific value of three samples of oil used was taken for purposes of calculation; this was 18,050 B.th.u. per lb., and the following results were obtained:—

Load.	Average revs. per min.	Average B.H.P.	Oil consumption. Lb. of oil per B.H.P. hour.
Overload	174.1	261.1	.403
Full load	175.57	235.9	.401
Three-quarter load	177.15	178.2	.405
Half load	179.33	119.9	.405
Quarter load ...	181.1	60.4	.506

A New Ceiling Rose.

We have received a sample of a new type of combined ceiling rose and block which is being placed on the market by the B.E. Co. (OF LONDON AND BIRMINGHAM), LTD., of 57, Upper Thames Street, E.C. 4, and which is illustrated in fig. 2. The primary idea was to avoid the use of pottery, on account of its shortage, but the article is now submitted as being suitable for general use in any modern electric light installation. The device is a labour saver, inasmuch as both the block and the connections for the wires are fixed by means of two screws only in place of four with the ordinary type of pattress and ceiling rose. The wood pattress is so cut away that it is ready for fixing without the necessity for further drilling in any way. The base containing the usual ceiling-rose plates is of specially hard non-hygroscopic insulating material; the brass cover matches the standard tumbler-switch cover in general use, and can be finished in any style to suit the switches. The inside of the cover is lined with an insulating paint. The new rose should be capable of being employed in general use, and appears to be a step in the right direction towards that desirable aim of cheaper, but at the same time efficient, lighting fittings and installations.

FIG. 2.—A NEW B.E. CO. CEILING ROSE.

A Sand-mixing Machine.

The necessity for using only well-mixed sand in the foundry needs no elaboration. MESSRS. ALFRED HERBERT, LTD., of Coventry, inform us that they are now producing for stock a sand-mixing machine which aerates the sand, allowing all gas to escape, and crushes all lumps in it; the sand does not need to be milled before being mixed. The machine consists of a pedestal carrying two vertical spindles rotating at a high speed, one within the other. The spindles are driven in opposite directions by bevel gearing from a pulley on a horizontal shaft. The upper ends of the spindles carry two intermoving cages, the bars of which, passing each other in opposite directions at a great speed, do the mixing and dis-

integrating. The cages are covered by a dome-shaped casing which directs the mixed sand on to the floor and prevents it from flying about. The centre of the dome carries a hopper, into which the unmixed sand is fed, and from which it drops into the centre of the cages. The hopper can be lifted off for the purpose of cleaning. The mixer will deal with about 7 cwt. of sand per minute, its net weight is 2,401 lb., and it occupies a floor space of 5 ft. 1 in. by 4 ft. 6 in.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

35,528. "Electric fuses." O. Cracoanu. December 17th. (Germany, December 17th, 1919.)

35,626/7. "Protective devices for electrical power transmission systems." G. H. B. Bernard and E. M. Royce (Bernard). December 18th.

35,675. "Eletcric gas lighting devices." R. E. Wild. December 20th.

35,694. "Clip for regulating height of electric lamps." E. Beckton. December 20th.

35,710. "Junction boxes for electric cables." Callender's Cable & Construction Co. and H. McCrudden. December 20th.

35,715. "Electric circuit breakers, &c." H. Bacon and R. A. R. Bolton. December 20th.

35,734. "Electrical cable sockets or lugs." E. Scharpenberg. December 20th. (Germany, January 2nd.)

35,749. "Electrical condensers." H. W. Sullivan. December 20th.

35,755. "Calling devices operated by wireless signals." W. J. Davis. December 20th.

35,768. "Sparking plugs." H. Longton. December 21st.

35,775. "Superposing currents of different frequencies upon existing alternating current systems." A. M. Taylor. December 21st.

35,825. "Electric induction motors." G. H. Fletcher and Metropolitan-Vickers Electrical Co. December 21st.

35,826. "Reflector for electric bulbs." E. Arden-Pye. December 21st.

35,845. "Telephone systems." Automatic Electric Co. and Automatic Telephone Manufacturing Co. (Automatic Electric Co.). December 21st.

35,861. "Telephonic conversation meter." R. Ferry. December 21st.

35,889. "Electric horns for automobiles." R. C. Royston. December 22nd.

35,891. "Trolleys for electric tramways of the overhead conductor system." W. Lawrence. December 22nd.

35,912. "Ignition magnetos." E. Marelli. December 22nd. (Italy, December 24th, 1919.)

35,915. "Electric lamp locking ring." W. Methuen. December 22nd.

35,922. "Electrical instruments." M. B. Field. December 22nd.

35,931. "Means for detecting damaged ramps in train electrical control systems." R. Haddan (Regan) and J. B. Regan. December 22nd.

35,938. "Selector switches for automatic telephone systems." Western Electric Co. (Western Electric Co.). December 22nd.

35,950. "Thermo electric apparatus for heating flowing liquids." C. Masseroni. December 22nd. (Italy, May 24th.)

35,953. "Storage battery and recharging system." W. H. Thorpe and M. S. Willing. December 22nd.

35,976. "Electric driving device." Landis & Gyr Akt.-Ges. December 22nd. (Switzerland, December 26th, 1919.)

35,976. "Electro-chemical treatment of petrol cans for removal and prevention of corrosion." G. Inrig. December 22nd.

35,992. "Electric treatment of ores." A. Counas. December 22nd. (France, August 29th, 1919.)

36,015. "Cover for electric conduit boxes." G. Turnock. December 23rd.

36,019. "Electric control mechanism of race games." S. Grossi. December 23rd.

36,054. "Electric lamp holders." A. N. Haddow and A. P. Rutherford. December 23rd.

36,077. "Electric transmission cables." A. M. Taylor. December 23rd.

36,080. "Wireless aerials for ships." R. Tull. December 23rd.

36,082. "Electric switches." T. C. Frampton. December 23rd.

36,084. "Electric lamps with luminous discharge." J. Pintsch Akt.-Ges. December 23rd. (Germany, December 12th, 1917.)

36,086. "Electric valves." Soc. Anon. pour l'Exploitation des Procedes M. Leblanc-Vickers. December 23rd. (France, December 23rd, 1919.)

36,112. "X-ray plates." A. L. Landau and L. A. Levy. December 23rd.

36,116. "Converting direct current into alternating current by electrostatically-controlled installations." L. A. Hazeltine. December 23rd. (United States, November 28th, 1919.)

36,127. "Diaphragm mountings for telephones, &c." W. Stott and Telephone Manufacturing Co. December 23rd.

36,131. "High tension transformers." F. Dessauer and Veifa-Werke Vereinigte Elektrotechnische Institute Frankfurt-Aschaffenburg. December 23rd. (Germany, September 29th, 1915.)

36,132. "High tension transformers." F. Dessauer and Veifa-Werke Vereinigte Elektrotechnische Institute Frankfurt,Aschaffenburg. December 23rd. (Germany, October 7th, 1915.)

36,133. "Transformers." Reiniger, Gebbert and Schall Akt.-Ges. December 23rd. (Germany, May 16th, 1918.)

36,134. "High tension transformers." F. Dessauer. December 23rd. (Germany, June 23rd.)

36,135. "Petrol electric, &c., generating apparatus." H. J. Norballe. December 23rd.

36,142. "Electric controllers, starters, switches, &c." J. O. Powell. December 24th.

36,144. "Electrical booking indicator." C. E. Jones and E. W. Rice. December 24th.

36,165. "Telephone systems." Automatic Telephone Manufacturing Co. December 24th. (United States, December 27th, 1919.)

36,170. "Electrodes and electrolysis." H. Plauson and J. A. Vielle. December 24th. (Germany, July 6th, 1918.)

36,233. "Wireless transmitting apparatus." N. E. Davis and Marconi's Wireless Telegraph Co. (Davis). December 24th.

36,251. "Valve transmitters for wireless telegraphy and telephony." H. Morris-Airey, L. G. Preston, and G. Shearing. December 24th.

36,252. "Supports for filaments in thermionic valves, &c." B. Hodgson, S. R. Mullard, and L. G. Preston. December 24th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

4,948. "Electrolysis." M. A. Adam, J. Stevenson, A. T. Mabbitt, and J. Fieldhouse. February 27th, 1919. (154,635.)

11,966. "Hand-cart for transporting and operating wireless telegraph station in forward battle areas." C. A. Oliver. May 13th, 1919. (154,637.)

12,695. "Process and apparatus for the electrolytic decomposition of chlorides." R. Cataldi. May 20th, 1918. (127,255.)

17,620. "Work feeding attachment for electro plating apparatus." A. G. Snell. August 28th, 1919. (154,650.)

18,868. "Process of manufacturing electric steels." J. McConnell. July 30th, 1919. (154,659.)

21,169. "Method of and means for electrically controlling the throttle valve in internal-combustion engines for propelling vehicles." P. F. Smith and P. V. Powell. August 23th, 1919. (154,682.)

21,322. "Dynamo electric machinery." T. L. Reed-Cooper. August 30th, 1919. (154,691.)

21,340. "Moving brush gear for dynamo electric machines." W. F. Grafton and Grafton Dynamos, Ltd. August 30th, 1919. (154,692.)

21,515. "Automatic switching mechanism for use more particularly in telephone or like systems." Automatic Telephone Manufacturing Co. (Automatic Electric Co.). September 2nd, 1919. (154,698.)

21,691. "Electrical treatment of ferrous metals during casting." J. H. Wickett. September 3rd, 1919. (154,711.)

21,808. "Arrangement of electric welding apparatus." A. E. Frankling. September 4th, 1919. (Addition to 134,393.) (154,717.)

21,892. "Electrical frequency multipliers." P. Trichard. September 5th, 1919. (154,720.)

22,001. "Universal grinders, particularly of the electric type." A. E. White (Wisconsin Electric Co.). September 6th, 1919. (154,723.)

22,105. "Method of and apparatus for operating synchronous telegraph systems." A. E. O'Dell (Western Union Telegraph Co.). September 8th, 1919. (154,736.)

22,366. "Microphones." A. Thomas. September 11th, 1919. (154,729.)

22,714. "Electric lamps for police and like uses." Hiatt & Co. and A. D. Melson. September 16th, 1919. (154,735.)

22,787. "Galvanic batteries." O. Oldham, G. Oldham, and J. Oldham. September 16th, 1919. (154,737.)

23,616. "Variable limit switch for breaking the circuit of an electric motor operating printing machinery." H. V. James. September 25th, 1919. (154,752.)

25,176. "Pneumatically operated controllers for electric motors." British Thomson-Houston Co. (General Electric Co.). October 14th, 1919. (154,763.)

25,722. "Electrical fuses and distribution boards." H. J. Dean and W. Redmayne. October 21st, 1919. (154,767.)

27,565. "Centrifugally-operated electric switches." R. Haddan (J. B. Regan). November 7th, 1919. (154,779.)

28,199. "Machine tools provided with electro-magnetic chucks or work-holders." W. Carter and F. C. L. Brendell. November 13th, 1919. (154,785.)

30,230. "Electric insulators." E. Haefely et Cie. September 13th, 1919. (151,231.)

1920.

161. "Means for starting internal combustion engines, adapted also to be used for generating electric current." W. S. Jeal. January 2nd, 1920. (Addition to 144,509.) (154,809.)

775. "Electrically-heated garments." A. Negromanti. January 9th, 1920. (154,814.)

3,078. "Electrical connectors." K. W. Johansson. November 7th, 1919. (154,166.)

6,565. "Spark plug cleaner." Champion Spark Plug Co. October 18th, 1916. (138,493.)

8,102. "Process and apparatus for the manufacture of wire by electro-deposition." S. O. Cowper-Coles. March 18th, 1920. (154,833.)

12,135. "Electric welding." J. E. Pollak (Maschinenbau Akt.-Ges. Seebach). May 1st, 1920. (154,849.)

16,431. "Starting of electric arcs in lamps, rectifiers, and the like." Siemens & Halske Akt.-Ges. July 21st, 1919. (148,280.)

19,180. "Electro-magnetic chucking device." F. Krupp Akt.-Ges. June 18th, 1919. (147,141.)

20,414. "Electro-magnetic chucking device." F. Krupp Akt.-Ges. June 23rd, 1919. (148,457.)

23,181. "Electric vehicle controllers." G. L. Meyfarth. August 18th, 1919. (149,921.)

A New Aspect of Lightning Protection.—It has been the general opinion that an overhead distribution system with a dense load and many transformers offers a better target for lightning discharge than one with a scattered load. A recent investigation, reported in the *Electrical World*, however, makes it evident that where a lightning arrester is installed at each transformer the lightning has a multiplicity of paths through which the voltage gradient of the atmosphere may be smoothed out, when the density of the lightning arresters is high, with less trouble at the transformer. From careful tests made on the 4,000 V, 60-cycle distribution system of the Commonwealth Edison Co., it appears that the density of lightning arresters on this system is far more important than the actual type of arrester used. Curves show that where the density of transformers and arresters is 200 per square mile, not only is the percentage of disturbance due to lightning greatly reduced, compared to a density of 100, but the actual number of interruptions is cut nearly in half.

Of equal importance is the matter of protecting underground cables. Where these cables are connected to the overhead lines there is a transition point which is especially susceptible to lightning disturbances and which has given serious trouble in the past. The results obtained indicate that underground cables can be effectively shielded from lightning by increasing the density of arresters in the vicinity of the point at which the cable emerges.

Among the important conclusions drawn from the tests is that trees and buildings constitute effective barriers against lightning discharges. The records in Chicago show that many transformers have been completely shielded from lightning by their presence.